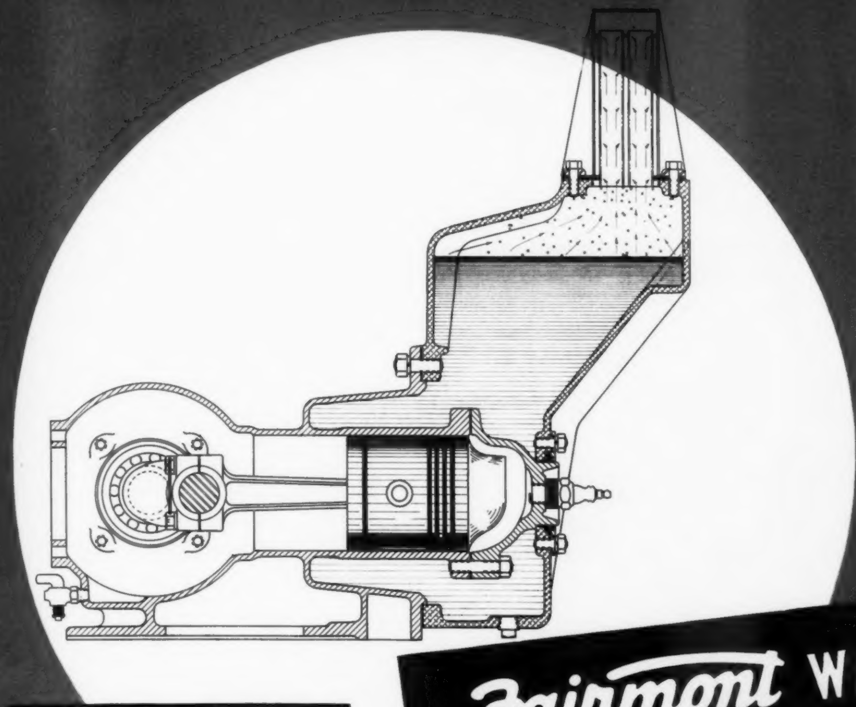
APRIL, 1939

Railway Engineering and Maintenance

Published monthly by Simmons-Boardman Publishing Corporation, 105 W. Adams St., Chicago, Ill. Subscription price: United States and Possessions, and Canada, \$2.00; Foreign, \$3.00. Single copies 35 cents. Entered as second-class matter January 20, 1933 at the postoffice at Chicago, Illinois, under the act of March 3, 1879, with additional entry at Mount Morris, Ill., postoffice. Address communications to 105 W. Adams St., Chicago, Ill.

Years Ahead in Design

FAIRMONT CARS HAVE THE FEATURES WHICH SERVE YOU BEST



Performance ON THE JOB COUNTS

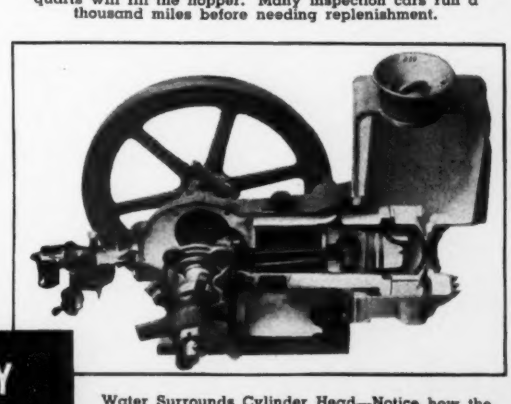
Fairmont WATER-COOLED ENGINES *NEVER OVERHEAT* AND ARE *FREEZE-PROOF*

Water circulates freely in the large hopper of a Fairmont engine. Steam, formed at the cylinder, rises to a point in the water jacket where a large cooling area dissipates the heat into the air. A condenser on top the jacket changes the steam back into water.

An important reason for the unfailing dependability of Fairmont motor cars is the highly efficient cooling system used in Fairmont engines. Water is the cooling medium and completely surrounds the cylinder and head. As the water boils, it dissipates the heat in the simplest and fastest manner, without the aid of complicated pumps, fans or blowers. Water-cooling—long the standard in automobile motors—is further improved in the Fairmont engine by the addition of a condenser which changes the steam back into water and makes frequent refilling unnecessary . . . Both hopper and water jacket are guaranteed not to burst from freezing.

Years ahead in design, Fairmont Motor Cars offer many other advanced features that make for more economical service—such as standardized and interchangeable parts, demountable wheels, and the endless cord belt drive. Write for details. Fairmont Railway Motors, Inc., Fairmont, Minnesota.

Fairmont engines need fresh water only occasionally. 9 quarts will fill the hopper. Many inspection cars run a thousand miles before needing replenishment.



Water Surrounds Cylinder Head—Notice how the water completely surrounds the cylinder head and extends back of the ports so that it cools the piston and 4 upper rings throughout the entire stroke.

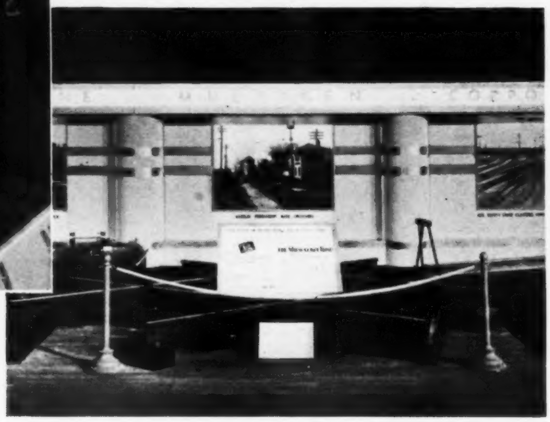
OF ALL THE CARS IN SERVICE TODAY

MORE THAN HALF ARE FAIRMONTS

A REAL *Center of Interest*

The ASSELIN Permanent Base (RUBBER CUSHIONED) CROSSING

Here are a few of the hundreds of visitors who inspected the Asselin Permanent Base Rubber Cushioned Crossing at the N.R.A.A. Exhibit in Chicago.



The center of the Pettibone Mulliken Display,—the crossing after more than two years of service.

An Outstanding Record

For more than two years, the Asselin Permanent Base Rubber Cushioned Crossing installed by the SOO LINE at Duplainville, Wis., has been a center of interest.

So that the greatest number of railroad men might be able to inspect this crossing it was especially removed and brought to Chicago for this exhibit. (It will be re-installed in Westbound track soon.)

From opening to closing time,—they came, and inspected! They found that the Asselin Crossing stood up under heavy tonnage and high speed,—being quieter and less expensive to maintain.

THE SOO LINE

Single Track—Traffic in both Directions

NORTHBOUND	
No. of passenger cars	22,135
No. of freight cars (loaded)	120,168
No. of freight cars (empty)	42,420
SOUTHBOUND	
No. of passenger cars	26,370
No. of freight cars (loaded)	103,980
No. of freight cars (empty)	45,420

TOTAL number all cars 360,493

THE MILWAUKEE ROAD

Double Track—Traffic Eastbound only

EASTBOUND	
No. of passenger trains	7,312
Approximate speed 60 to 80 MPH	
No. of freight trains	4,015
Approximate speed 25 to 50 MPH	
Approximate number of freight cars	262,820

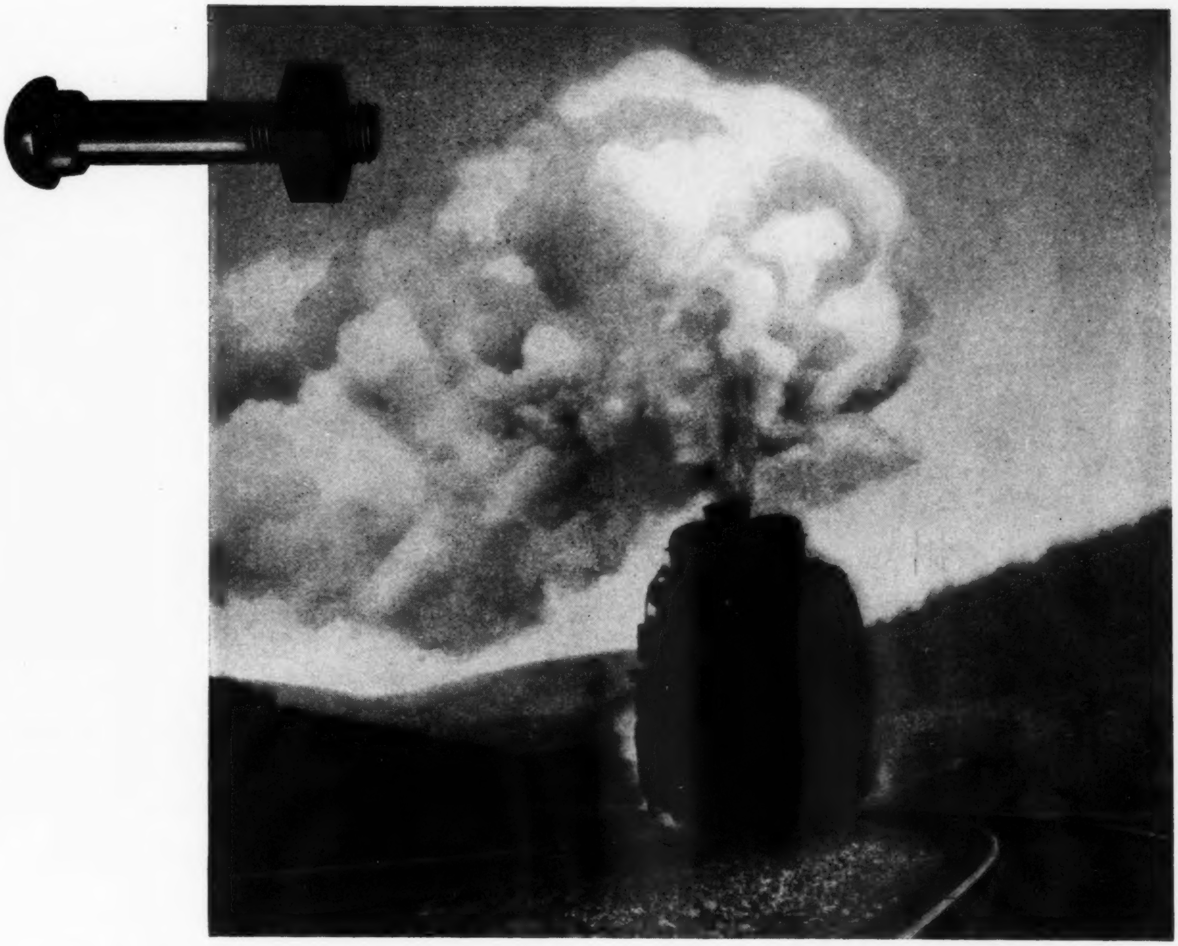
Approximate tonnage 10,720,050

NUMBER AND WEIGHT OF LOCOMOTIVES NOT INCLUDED IN ABOVE FIGURES

There are much more interesting data, including actual sound recordings of trains passing over the two types of crossings at this location. These electrical transcriptions are available to interested railroad men. Write us.

PETTIBONE MULLIKEN CORPORATION

4710 West Division Street -:- -:- Chicago, Illinois



TO RAILWAY SUPPLY MANUFACTURERS

"Backing Him Up"

Railway Engineering and Maintenance Goes Every Month to 128 Supervisory Maintenance Officers on the Southern Pacific at **2 General Offices, 13 Division Offices and 59 Other Supervisory Headquarters,** Scattered All the Way from San Francisco, Cal., to Portland, Ore., Ogden, Utah, and New Orleans, La. This Magazine Also Goes to 77 Other Subordinate Officers Who Are in Training for Promotion to Supervisory Positions on Those Lines.

"Bill, why is it that we're getting no business from the . . . Railroad? I've checked your reports and find that you're calling on the chief engineer maintenance regularly. And your reports indicate that he's friendly to us."

"That's true, Boss."

"Why can't we get some business from him then? He's using a lot of our kind of material."

"I know it, Boss. But do you really want to know what's the trouble?"

"I certainly do. Let's have it."

"Well, here it is. The chief IS a fine fellow. He's friendly to me and to our company but his men out on the line want the . . . Company's material."

"Well, can't he tell them what to use?"

"Certainly he can but he won't."

"You mean that he lets his division engineers and roadmasters select what they want?"

"In effect, yes. He says that they know their local conditions best—and he depends a lot on their judgment."

"But the . . . Company doesn't call on these men out on the line. Their sales staff is smaller than ours."

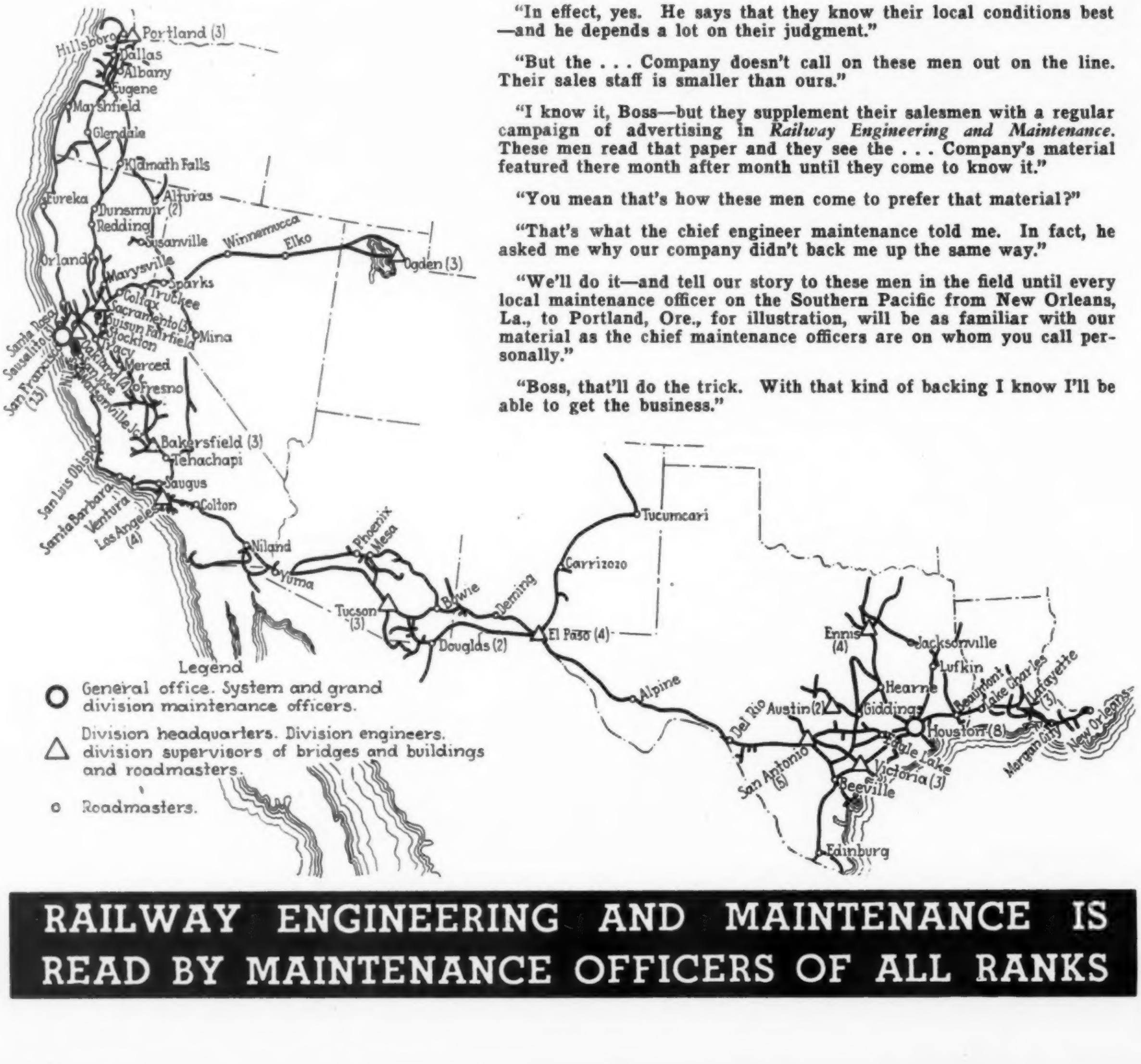
"I know it, Boss—but they supplement their salesmen with a regular campaign of advertising in *Railway Engineering and Maintenance*. These men read that paper and they see the . . . Company's material featured there month after month until they come to know it."

"You mean that's how these men come to prefer that material?"

"That's what the chief engineer maintenance told me. In fact, he asked me why our company didn't back me up the same way."

"We'll do it—and tell our story to these men in the field until every local maintenance officer on the Southern Pacific from New Orleans, La., to Portland, Ore., for illustration, will be as familiar with our material as the chief maintenance officers are on whom you call personally."

"Boss, that'll do the trick. With that kind of backing I know I'll be able to get the business."



RAILWAY ENGINEERING AND MAINTENANCE IS READ BY MAINTENANCE OFFICERS OF ALL RANKS

No. 124 of a series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Advertising the
Spark Plug of Progress

April 1, 1939

Dear Reader:

Have you ever considered the extent to which advertising is the spark plug of civilization? Do you appreciate the extent to which it determines what we eat, what we smoke, what we wear? Do you realize how it establishes our standards of living by creating a demand for the products of the manufacturer and the inventor?

We in America are an advertising-minded people. As a result, many things that are still regarded as luxuries in other countries are today considered household necessities in America. No other country approaches our standard of living.

This observation applies just as directly to railway maintenance practices. Nowhere else in the world are as many new materials, new devices in general use. Nowhere else do such materials and devices receive universal acceptance as quickly as in America, and nowhere else are they brought to the attention of railway officers and their merits told so quickly.

It is a tribute to the aggressiveness of American railway supply manufacturers that this is true. It is equally a credit to the alertness of you railway maintenance officers that you search the pages of Railway Engineering and Maintenance so thoroughly each month to see what is new.

We are happy to provide this medium for service to manufacturers and railway men alike. This is our part in the placing of the American railways on the highest plane of maintenance practices in the world. We are proud of the record that you are making. We are proud to think that we have a part in it.

Yours sincerely,

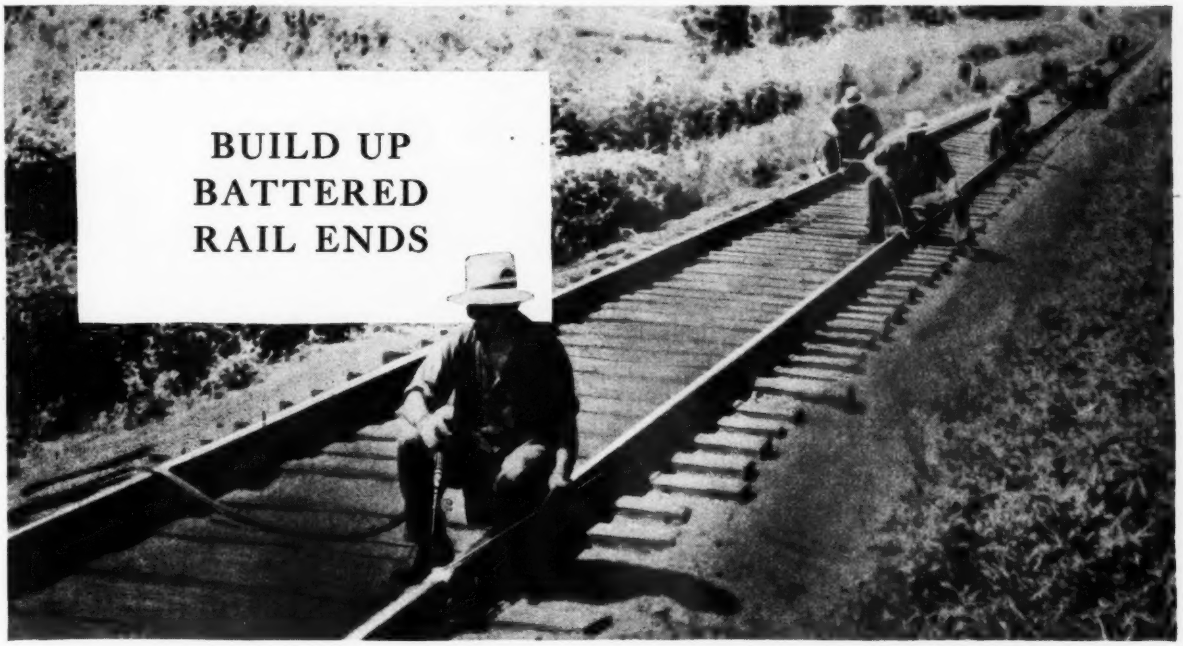
Elmer T. Howson

ETH:EW

Editor

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

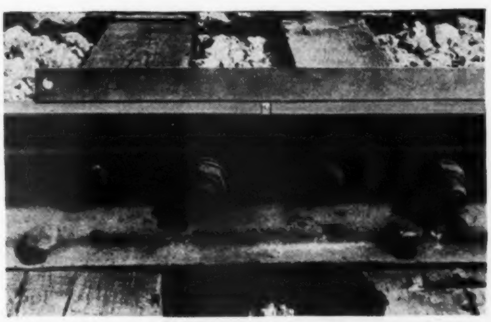
For Smooth-Riding Track



MORE comfort for passengers and less jouncing for freight result when battered rail ends are built up to original surface. Additional important advantages of rebuilding rail ends are reduced wear on joint bars and ties, lowered maintenance costs for track and equipment, and longer rail life. It is noteworthy that, year after year, increasing thousands of miles of track are kept smooth-riding because rail ends are built up by methods which Oxweld has developed and is constantly improving.

In addition to bringing oxy-acetylene welding and cutting to railroads, Oxweld Railroad Service provides heat-treating of rail ends, hard-facing of wearing parts, pressure welding of rail, and "Unionmelt" electric welding. For profitable use of these processes, consult The Oxweld Railroad Service Company, Unit of Union Carbide and Carbon Corporation, Carbide and Carbon Building, Chicago and New York.

Battered rail ends (under straightedge) hasten depreciation of track and rolling stock.



Rail ends are smooth and harder than the original rail when built up under "Oxweld" procedures.

OXWELD
RAILROAD SERVICE

SINCE 1912

OVER A QUARTER CENTURY OF SERVICE TO THE MAJORITY OF CLASS I RAILROADS

The words "Oxweld" and "Unionmelt" are registered trade-marks of Units of Union Carbide and Carbon Corporation.

Published on the first day of each month by the

SIMMONS-BOARDMAN PUBLISHING CORPORATION

105 West Adams Street, Chicago

NEW YORK
30 Church Street

CLEVELAND
Terminal Tower

WASHINGTON, D. C.
1081 National Press Bldg.

SEATTLE
1038 Henry Bldg.

SAN FRANCISCO
485 California Street

LOS ANGELES
Union Bank Bldg.

Subscription price in the United States and Possessions, and Canada, 1 year $2, 2 years $3; foreign countries, 1 year $3; 2 years $5. Single copies, 35 cents each. Address H. E. McCandless, Circulation Manager, 30 Church Street, New York, N.Y.

Member of the Associated Business Papers (A.B.P.) and of the Audit Bureau of Circulations (A.B.C.)

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

APRIL, 1939

Unsound CONCRETE RESTORED *Throughout*

Above view shows conditions in 5600′ tunnel before repairs were started. Note water pouring through lining.

Right: Intrusion material being forced *into* the structure under pressure. Note water being forced out of voids in concrete.

Below: "Case-hardening," or proofing the surface against deterioration, making the surface *in itself* dense and durable.

The "INTRUSION" METHOD

is an exclusive *engineered* procedure for the complete restoration of structural concrete or masonry that is unsound.

With this method available, WHY TRY to make LASTING REPAIRS by a SURFACE PATCH! *Add* stability and strength—make the structure *solid throughout.*

Regardless of depth of the trouble, the ENTIRE MASS is solidified. All voids or honeycombed areas are *filled*, and the surface "case-hardened" with special material to prevent further action of destructive agencies.

The expert planning—the trained organization—the special materials and equipment needed for this work, are *all provided* by us. We assume all responsibility . . . from initial cost estimates to the final execution of the work.

Consult us about YOUR structural concrete or masonry problems, whatever they may be.

Years of field experience and independent research, have demonstrated the soundness of the "INTRUSION" METHOD. Methods and materials protected by patents and patents pending, and used exclusively by

LOUIS S. WERTZ, Inc. The DUR-ITE CO.

General Offices

9 S. Clinton St., Chicago, Ill.

District Offices: Marion Building, Cleveland, O.—406 Crocker Building, San Francisco, Cal.—W. Vliet at North 20th St., Milwaukee, Wis.—934 St. Catherine Street East, Montreal, Que.

An article describing in detail the repairs to the 5600′ Franklin tunnel of the Santa Fe, was published in the March 4th issue of the RAILWAY AGE.

Railway Engineering and Maintenance

Confusion

Regarding Deferred Maintenance

HOW much deferred maintenance exists on the railways? This is the most debated question among railway maintenance officers today. There is no agreement among them as to the total accumulation of deferred work—because there is no agreement among them as to the standard of maintenance with which comparisons should be made. It varies with each individual road and with different units on any one property.

Yet, in the face of this divergence in viewpoint among those who are in most intimate contact with the properties, the Bureau of Statistics of the Interstate Commerce Commission has attempted to arrive at a composite figure for all the roads, only to add still further to the confusion. The very nature of the inquiry that it addressed to the roads demonstrated a confusion of thinking on the part of those who drafted the questionnaire, for it was so worded as to convey the impression that the Bureau considered that the amount that the roads should spend to enable them to handle a volume of traffic equal to that of 1937 as the same amount that would be necessary to make good the total deferred maintenance on the railways that has accrued to December 31, 1938. Yet these are two widely different bases.

Traffic Capacity Not a Measure

In the first place the ability of a railway to handle a given volume of traffic safely bears little relation to the state of maintenance of many units of the property at that time. Most obvious expenditures of this character are those for the painting of buildings—a task that can be postponed for a considerable time without endangering safety but that must be made good eventually, and at greatly increased cost, if the property is to be maintained efficiently. Similar illustrations are afforded by the cleaning of cut ditches, the restoration of embankment shoulders, the cleaning of ballast, etc.

Going a step further, one faces the necessity for drawing a line of demarcation between those expenditures that are made solely or primarily to insure safety of operation and those expenditures that are made to reduce the cost of maintenance and effect most economical upkeep of the property. For illustration, it is entirely practicable to maintain track to good line and surface with 90-lb. rail and a light ballast section *if enough labor is employed,* but the railways have amply demonstrated the economy of heavier rail and more and better ballast in reducing the cost and increasing the dependability of operations.

Ultimate Economy the Goal

Until within the last 15 years there were long periods of time when it was a fair question whether the track was strong enough to carry the loads placed on it with adequate safety. In the early "twenties," however, this fear disappeared, for the aggressive programs of rehabilitation of roadway and structures that were initiated following the return of the roads from federal control eliminated this consideration and the roads progressed definitely beyond the minimum level of safety to the higher level of ultimate economy. As a result, the standards of roadway maintenance had progressed far beyond the minimum requirements of safety by 1929, although they had by no means attained the maximum level which could be justified on the basis of economy.

When the depression struck, with its drastic reduction in earnings, the railways reduced their expenditures for the upkeep of their properties accordingly. They were able to do this with safety, for they were, in effect, drawing on the reserve that they had built into their properties in the more prosperous years. They have continued to draw on this reserve in varying rates for nearly 10 years. The extent to which they can continue this is difficult to determine. It varies with different properties—with different units of the same property.

Which Basis?

In view of this record, it is pertinent to inquire from what level deferred maintenance should be computed. Is it that level of maximum ultimate economy towards which the roads were progressing in 1929? Or the level which prevailed in 1929? Or is it that minimum level at which the roads can handle their traffic with safety? These are widely differing levels, a fact which those who drafted the questionnaire failed to recognize.

That the railways were equally confused regarding the intent of the questionnaire is indicated by the wide variation in their replies. The fact that after 10 years of greatly reduced expenditures 48 roads reported that they had no deferred maintenance indicates that they were

working from the lower level. The fact that other roads in equal or better condition reported large accumulations of deferred maintenance indicated that they were starting from their pre-depression standards. We believe that the latter is the correct basis from which to start, for the railways are charged with responsibility for *economical* as well as safe operation. We believe also that this obligation is recognized by railway managements, for only on this ground can the purchase of more than twice as much rail this year as compared with 1938 be explained. Given the earnings, the railways will begin to rebuild their properties to the levels that will afford most efficient and most economical operation. They have shown that determination with every increase in earnings. They are showing it again this year.

It is to be regretted that the Commission issued its questionnaire in the form that it did, for the returns that it received afford little information of value. The figure arrived at by tabulating the replies is entirely too large on a "barely get by" basis; it is but a fraction of the total that would be required to restore the railway properties to the 1929 level of efficient operation.

Canted Tie Plates

Eccentricity Demands Careful Attention

FOR years section and rail-gang foremen on numerous roads habitually adzed ties in such a way as to give the rail a slight inward cant. When canted tie plates first came into use some of them, not being informed of the purpose of these plates, continued their former practice and at once got into trouble, for, although the rail was laid to correct gage, the gage became tight and the track had to be regaged.

Apparently it did not occur to them to change their adzing practices, the obvious remedy from their point of view being to widen the gage about 1/4 in., so that it would eventually return to correct gage. However, it was the common experience that rail laid in this manner always gave trouble with respect to keeping correct gage, for the tendency of the gage to tighten did not stop when it had reached correct gage, although the inward tipping of the rail then progressed more slowly.

By changing the adzing practices to produce level seats for the tie plates conditions were greatly improved, but the trouble was not cured, one reason being that hand adzing is never uniform. With the advent of the tie adzer a still further improvement was noted, yet the trouble remained, for the gage continued to tighten, sometimes as much as 1/4 in.

Further investigation has indicated that there is a direct relation between the eccentricity of the tie plates and the change in gage. In other words, if the toe on the gage side of the plate is too short, there is a definite tendency for the rail to tip in under traffic loads, and this becomes more pronounced as the cant in the plate or the height of the rail section is increased.

Even with plates of well-balanced design, some tendency to tip remains. Where 112 or 131-lb. rail is laid on tie plates having a cant of 1 in 40, and where the adzing has been done carefully, it is not uncommon for the gage to be 1/8 in. tight after the plates are seated. If the plates are not balanced and the inner toe is too short, the change is likely to be still greater. While it is highly undesirable to lay rail to wide gage, even this remedy is impracticable where the ties are prebored. On the other hand, many experienced maintenance officers do not look with disfavor on gage that is 1/8 in. less than standard, especially where high-speed trains are being operated. It appears to be desirable, however, on those roads that are having trouble with the tightening of gage, that serious consideration be given to the question of eccentricity in the design of their tie plates.

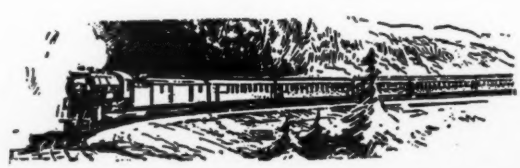
Rail Laying

Prepare for a Busier Year

FROM every indication, 1939 will be a big rail-laying year, as compared with 1938, and, in fact, as compared with any year since 1931, with the exceptions of 1936 and 1937. To the present time, orders for more than 550,000 tons of rail have actually been placed for 1939 renewals, with orders for another 150,000 tons pending, which indicates that between 800,000 and 1,000,000 tons of rail will be laid this year. This compares with an average of approximately 400,000 tons laid annually in the years 1932 to 1935, inclusive; 900,000 to 1,000,000 tons laid in each of the years 1936 and 1937, and substantially less than 400,000 tons laid in 1938. In other words, the 1939 program, although small as compared with the programs of 1925 to 1929 when approximately 2,000,000 tons were laid annually, looms large as compared with the programs of most of the years since 1931, and bids fair to more than double the 1938 program.

This increased rail-laying activity, scheduled for the months immediately ahead, not only places increased work on the maintenance of way forces, but largely increased responsibilities. Insistent as the demand has been for economy and efficiency in maintenance of way operations in recent years, it was never more important than today. This means that, marked as the developments have been in rail-laying methods and organizations in the past, maintenance men must still be constantly on the alert to develop even more efficient methods and organizations, to the end of adding to the remarkable advances already made in this regard, and to reduce to the lowest practicable figure, with safety, the cost of putting the 1939 rail in the track.

Alert as many railway maintenance officers have been to this development in the past, the thought suggested is not out of order when it is considered that for several years not a few maintenance men, without new rail to lay, have not been confronted with rail-laying problems, while



others, with small quantities to lay, have employed methods which they realize would not be conducive to the greatest efficiency if a large quantity of rail was involved. Furthermore, many of the track forces, from supervisory officers to those who must handle the simplest details of the actual rail-laying operations, who will be called upon to lay rail this year, may not have been involved in organized rail-laying work for several years, and, as a result, may not be as skilled in the latest refinements which have produced such commendable results under more favorable circumstances in the past.

Faced with these conditions, it behooves every maintenance officer, and especially those in responsible charge in the field, who will be faced with rail-laying work during the current year, to give most careful consideration to all of the developments in equipment, methods and organizations in the past, and to adapt them to their own particular conditions to the best possible advantage. At the same time, they may well bear in mind that, outstanding as these developments have been in the past, there will always be opportunities for refinements in details, if not in general practices, which, taken advantage of, may improve materially upon what has been considered favorable performance heretofore. These considerations go far beyond the matter of speed in laying rails in the tracks or the cost per ton of rail in place as of the time the rail-laying force moves on. These are important considerations, but coupled with them are many other factors which must also be taken into account, including that of minimizing interference with train operation; the completeness of the work, to avoid throwing difficult, costly tasks upon the regular section forces; and the all-important factor of highest quality work, to insure future economical maintenance and maximum service life of the new rail.

Motor Cars

Accidents in Handling Are Avoidable

WHEREAS the typical section gang 10 years ago consisted of 6 to 8 men, and on some roads of 10 men, the typical gang of today has only 2 to 3 men. Most of the section motor cars purchased up to 1930 weighed from 1,100 to 1,400 lb., and it was never an easy task to remove them from the track except at road crossings, at section tool houses or at specially constructed motor-car set-offs. This routine operation of setting motor cars off and on the track has resulted in many personal injuries.

As the number of men in the gangs decreased, the difficulty of removing and replacing these heavy cars increased so much that it became extremely hazardous. Motor-car manufacturers were quick to respond to the new conditions, with the result that they now offer cars of much lighter weight, making them far easier to handle. The railways, so far as their resources have permitted during the difficult period since 1929, have been replacing these older and obsolete cars with the newer light-weight designs. However, while the manufacturers have done their part, it is beyond their ability to remove those hazards that result from improper methods of handling the cars when taking them off or setting them on the track.

In removing a motor car from the track, or in replacing it, it is of first importance that every man engaged in the operation have a clear understanding of what is to be done and of what is expected of him individually. Such injuries as crushed feet, broken legs, strains and hernia, are entirely avoidable. They can invariably be traced to lack of understanding or lack of co-ordination on the part of one or more men engaged in the handling of the car. Every man who is to have a part in the handling of the car should be assigned definitely to his place and the foreman should know that he understands what he is to do. Others should stand far enough away not to interfere or cause confusion and should not attempt to assist. No man should be permitted to lift the side of the car and then attempt to walk backward with it, for even with enough men to bear the load the footing on the ballast shoulder is seldom dependable and the operation cannot be other than hazardous so that injuries must be expected.

If the car is equipped with a free-running engine, the engine should be stopped before attempting to move the car, to avoid the possibility of the clutch becoming engaged or the belt being tightened, thus revolving the driving wheels; otherwise clothing or hands may be caught and serious injury result. The front wheels should be lifted from the rails on the side toward which the car is to go. The rear end should then be swung around and the front wheel lifted over the rail, and the car should then be shoved to clear the track. Care must be exercised, however, especially with high rail, to avoid pinching fingers between the rail and the lifting handles of the car.

Too many times when injuries occur in the handling of motor cars, the cause is attributed to clumsiness on the part of the injured person. In most cases a thorough investigation will disclose that the foreman has not taken the trouble to assign the men or to know that each of them has a complete understanding of what he is to do. Again, he may have assumed that the men were so familiar with the operation that no supervision was needed. A mistaken belief that no hazard is involved because of long experience in the handling of motor cars often gives rise to unsafe practices. For these reasons no report of personal injuries incurred in the handling of motor cars should be filed until all of the facts have been uncovered. It will generally be possible to trace the ultimate cause to failure on the part of the foreman, and perhaps of the supervisor, to train the men properly and to enforce the simple rules that practically eliminate hazards. Once the foreman is convinced of his responsibility, however, he will react to insure complete enforcement of the rules.

Rodman Making a Sounding While Holding Bow of Boat in Position by Pulling on Anchor Rope. Note Man in Stern of Boat Is Assisting in Holding the Boat with a Section of Pipe

Checking the Stream Bed About Bridges

By N. H. WILLIAMS
Transitman, Delaware & Hudson, Carbondale, Pa.

THE serious troubles experienced by several eastern roads as the result of the unprecedented floods of March, 1936, January, 1937, and again in September, 1938, and on certain western roads by floods early in March of 1938, have given added impetus to the development of a procedure for the systematic underwater inspection of bridge piers and abutments, and for the gathering of pertinent stream bed data above and below bridges, as well as in the area directly surrounding their supporting masonry.

Bridge substructures and the stream bed about them should be inspected regularly and carefully; otherwise, it will not be known when underwater damage has occurred, since that portion of a structure above the water level may give no indication of a serious condition below the water surface. Underwater inspections will usually bring to light indications of impending failure. They may give warning in the disclosure of visible failures in the masonry due to such factors as the overloading of the foundation, the reduction of the foundation area, the overloading of individual stones, the washing out of the mortar between the stones, surface disintegration, and scour about the footings. Where scour has occurred, this can be determined usually by sounding, although in some cases it can be detected only by the use of a professional diver.

Program on the D. & H.

The importance of regular, periodic inspections of those portions of bridge substructures which are normally under water has long been recognized on the Delaware & Hudson. As a result, a systematic method of stream and pier inspection is a regular part of this road's normal bridge inspection program. In addition, during each storm of considerable magnitude, the division engineering and bridge and building forces are sent out to make emergency inspections of all important structures. In the case of its three important bridges across the Susquehanna river near Wilkes-Barre, Pa., the D. & H., in addition to making a careful check periodically of the condition of the piers and abutments, has for several years made a detailed survey of the river bottom in the vicinity of each bridge and has kept an accurate record of the conditions found.

The Susquehanna near Wilkes-Barre is approximately 800 ft. wide during periods of low water, and at such times, except in the middle of the channel, is rarely more than 10 to 15 feet deep. During periods of high water, and especially at flood stage, however, it overflows its banks and spreads out over the adjacent lowlands, and at such times the current in the main channel becomes a swift and powerful agent of destruction, menacing everything in its path. In view of these conditions, the three bridges crossing the river are given an emergency inspection during each flood stage, which is followed by a more detailed inspection and a survey of the river bottom about their piers and abutments after the water recedes. Soundings of the river bottom above and below these bridges are also made in August of each year, in conjunction with a complete inspection of the bridges themselves, this being the time when the water level is usually the lowest and the conditions for such work most favorable. Soundings about the structures are also taken in the winter when the river is frozen over.

To secure comprehensive information concerning the condition of the river bottom when taking soundings, the soundings are taken from shore to shore along two lines parallel with the bridges, one upstream and the other downstream, usually at a distance of 200 ft. from the structures. In addition, another cross section is taken from abutment to abutment along the center line of each structure. At the same time, the river bottom around each of the bridge supports is surveyed by taking soundings along 11 radial lines from each pier, and along 3 lines out from the face of each of the bridge abutments.

Supplementing the records secured of the elevation of the bottom, notation is made at each sounding point of the character of the bottom, as mud, silt, gravel or rock, to indicate its susceptibility to wash or scour. Where the depth of the water does not exceed 8 to 10 ft., fairly accurate classification of the bottom is possible by feel or sound. Even where the soundings are made in water too deep for the man making them to distinguish between the various materials comprising the bottom, he is usually able to determine at least whether the bottom is hard or soft.

Equipment Necessary

The sounding party consists usually of four men, three furnished by the engineering department and one by the bridge and building department. The equipment required by the party, in addition to the necessary surveying instruments, includes a flat-bottom rowboat; two anchors and 400 ft. of ¼-in. rope for use in maneuvering the boat into proper position for soundings; a two-section, self-reading level rod, with a metal shoe to protect its end when probing; three 8-ft. lengths of ⅜-in. pipe, painted in 1-ft. graduations alternately red and white, for use where the depth of the water exceeds 14 ft.; a 12-in. section of pipe with a 90-deg. elbow, which can be fastened to the 8-ft. sections for probing around the bottom and sides of piers; and hip boots for each member of the party. A sounding lead is not used, because it is practically impossible to take accurate soundings with it in any appreciable current.

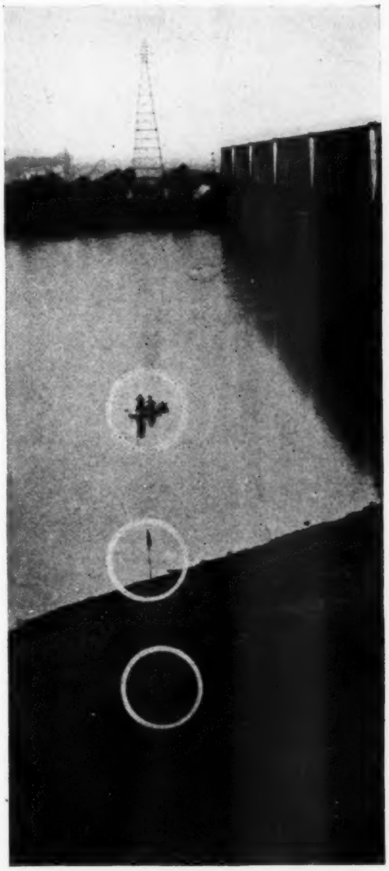
Rapid conduct of the work requires that the men stand up and move about in the boat, so that it is essential that those assigned to the work be able to swim well. Furthermore, they must frequently go over the side of the boat about piers to inspect the masonry under water. In places where the water is less than five feet deep, the work can be speeded up greatly by having one or two men in the water to push the boat about as desired and to hold it stationary while soundings are being taken.

Taking Sections Across the River

The usual sequence of steps in making a survey of the river bottom upstream and downstream from a bridge is as follows: First, points are laid out along and marked on the deck of the bridge at 25-ft. intervals. Then the elevation of the water surface is determined, and the water level is clearly marked on a convenient pier. Since the water surface is used as a

Recognizing the importance of safeguarding its bridges by ascertaining periodically the condition of the stream bed about them, the Delaware & Hudson makes frequent underwater inspections of all of the important structures on its lines, which include surveys of the stream bed both above and below the structures as well as directly around their piers and abutments. The manner of making these inspections, as carried out at this road's three important bridges over the Susquehanna river near Wilkes-Barre, Pa., is described in this article

plane of reference, this mark is observed frequently during the progress of the work in order that the necessary corrections may be made in case the water level rises or falls. Next, the range lines for the sections to be taken above and below the bridge are established parallel with the structure.



Party Taking a Cross Section. Note the Range Poles with Flags on Them (Enclosed in Circles) in the Foreground

In doing this, two flags are set on each range line, on the same side of the river, usually several hundred feet apart. Soundings along these lines are then taken from shore to shore, at intervals of 25 ft., "tied in" with the stationing on the bridge.

The boat of the sounding party is kept on the proper course by sighting the two flags on the range line being followed, this being the responsibility of the oarsman. The rodman of the party makes soundings immediately upon receiving signals from a man stationed on the bridge. This man stations himself successively at the 25-ft. intervals laid out initially, and with a right-angle prism sees that the soundings are taken on lines at 90 deg. from the line of the bridge. The chief of the party, who is the third member of the boat crew, keeps the record of the soundings and directs the work, and sees that each sounding is taken correctly.

Soundings Around the Piers

In investigating the condition of the river bottom about the piers, soundings are taken along 11 lines extending out from their faces, at intervals of 5 ft. for a distance of 25 ft. It is essential that the boat be stationary when these soundings are taken so that each point will be located accurately. This is to insure securing accurate information regarding silting or scouring, and the detection of other possible damaging influences which might come into play and menace the bridge during the next period of high water.

When the current is sluggish, the soundings about the piers can be taken rapidly without difficulty, with all men working from within the boat. When the current is swift, however, it frequently becomes necessary to have two men stand on the river bottom close to the piers to maneuver the boat into the various positions for taking the soundings. Where the water is too deep for men to maneuver the boat in this manner, it is held at the points desired by ropes extending from drop anchors located approximately 50 ft. upstream and about 75 ft. apart. This means of anchoring has proved highly effective in nullifying the pull of adverse winds or current, and in steadying the boat at each sounding point. Another method of anchoring the boat under such conditions, which has proved highly successful, is the use of pipe anchors. For this method, the boat is equipped with two pipe sockets on each side, through which lengths of ¾-in. pipe can be passed to a firm hold on the river bottom. Each of the sockets consists of 1¼-in. pipe sleeve welded

RECORD OF SOUNDINGS BR. NO. R95.48												Page 16
DATE	ELEVATION FACE	BOTTOM	ELEVATION 0+05	BOTTOM	ELEVATION 0+10	BOTTOM	ELEVATION 0+15	BOTTOM	ELEVATION 0+20	BOTTOM	ELEVATION 0+25	BOTTOM
SECTION C-D							WEST ABUTMENT					
8/34	509.5	M	508.1	S	507.2	G	506.2	M	504.2	G	502.5	M
8/35	509.2	M	508.6	G	507.1	G	504.5	R	503.8	G	499.7	R
8/36	509.0	S	509.0	S	506.0	R	504.6	R	502.6	R	499.6	R
8/37	509.8	M	508.6	M	506.3	S	503.7	R	503.2	G	500.7	S
SECTION A-B							PIER NO. 5					
8/34	507.7	G	507.2	G	506.7	G	504.1	G	504.0	G	502.3	G
8/35	507.2	R	506.8	G	506.5	G	505.5	G	504.9	G	503.5	G
8/36	507.0	R	506.8	G	507.1	G	506.1	G	505.3	G	503.7	G
8/37	507.2	R	506.6	R	506.5	G	506.5	G	506.2	G	505.3	G
SECTION C-D							PIER NO. 5					
8/34	507.3	G	506.8	G	506.5	G	506.2	G	504.9	G	504.5	G
8/35	506.0	G	505.8	G	506.0	G	505.8	G	504.6	G	504.5	G
8/36	505.2	R	504.5	G	504.7	G	504.9	R	504.4	G	503.6	R
8/37	505.8	R	504.7	R	504.6	R	505.1	R	504.6	G	504.6	G
SECTION E-F							PIER NO. 5					
8/34	506.3	S	507.0	S	504.9	G	505.1	S	504.4	R	502.9	B
8/35	505.6	R	505.2	R	504.4	G	504.2	G	503.9	R	501.3	B
8/36	505.7	R	504.8	R	504.1	R	504.1	G	504.0	R	502.8	B
8/37	506.2	R	504.4	G	504.2	G	504.9	G	504.1	G	503.9	B

—LEGEND—
G=GRAVEL; S=SAND; R=ROCK; B=BOULDERS; M=MUD.

A Replica of a Portion of the Office Record Designed to Give a Comparison of the Elevations and the Condition of the Bottom at Each Point Over a Period of Years

to a piece of strap iron, which is, in turn, bolted to the side of the boat. When anchoring by this method, the pipes are always inserted in the sockets on the upstream side of the boat to avoid the possibility of its being capsized by the current.

At the time of making the survey of the river bottom about the piers and abutments, the masonry itself is carefully inspected for defects. Where there is any question, the piers are checked for tilting by dropping plumb lines along their sides at both ends. Points at which the plumb lines are held are marked with paint so that subsequent observations can be made at the same locations. Where settlement is suspected, elevations are taken along the sides and at the ends of the pier, and are compared with corresponding elevations recorded during previous inspections. Sketches, sometimes supplemented by photographs, are made of any defects that are discovered, and recommendations for their repair are noted in the field book.

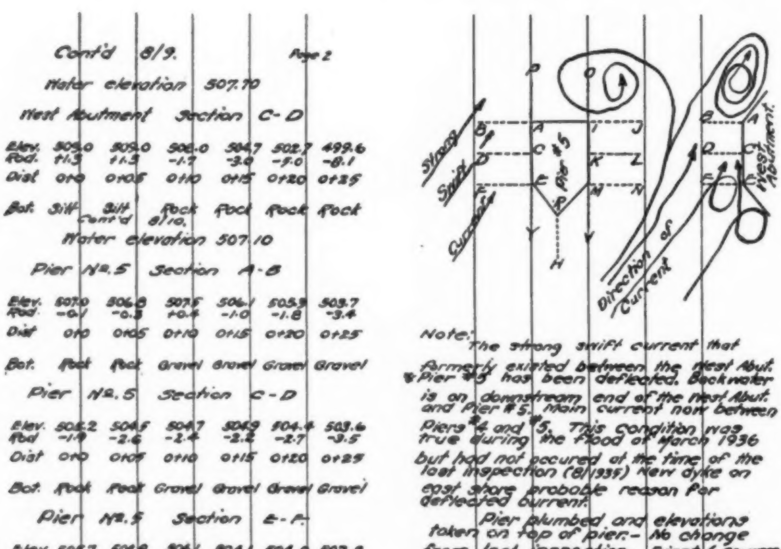
When an inspection party goes out on a bridge inspection such as has been described, it is furnished a preliminary report, listing any defects found previously in the masonry and indicating any symptoms of possible failure noted at the time of the last inspection. Before leaving the bridge, this list is checked carefully by the bridge and building master or his assistant against the new inspection data to make sure that nothing has been overlooked.

When taking soundings about the Susquehanna River bridges during the winter, when the river is frozen over, as is the practice as was pointed out earlier in this article, the locations of the various sounding points are laid out on the ice and the soundings are taken through holes cut in it. If the river is not frozen over at the time the winter inspection is to be made, the inspection is carried out from a boat as already described.

Field Notes

Important features of the inspection procedure followed are the manner of recording field notes and the establishment of satisfactory methods of compiling the information in a permanent office record so that observations of each year's inspection may be compared conveniently and effectively with those of previous inspections. One of the accompanying illustrations is a reproduction of facing pages from the field book containing the record of a river bed survey made at one of the bridges crossing the Susquehanna. It will be noted that the sounding data are supplemented by sketches showing the direction of the current and any eddies around the piers and abutments, these sketches being made at the time of the inspection. These sketches frequently make it possible to forecast the points where scouring will occur and have been found invaluable when used in conjunction with the sounding data over a period of years. In another illustration, a portion of the office record is shown, in which, it will be noted, the elevations observed at various points about the bridge are entered under corresponding elevations observed in previous inspections.

The time required to make a complete underwater inspection about a bridge varies widely with the size of



Two Facing Pages of Field Notes Taken on a Survey of One of the Bridges Crossing the Susquehanna, with a Typical Sketch on the Right Hand Page Showing the Direction of the Current and Eddies Around a Pier and Abutment

the bridge and the character of the waterway crossed. To complete the taking of a cross section from shore to shore, as described, when the river is from 800 to 1,000 ft. wide, requires from 1½ to 3 hr. The time required to complete a survey about a pier close to shore in shallow water, where the work can be carried out without the use of a boat by men wearing hip boots, will be from 30 to 40 min. On the other hand, a complete survey by sounding about a pier in deep, swift water may take from 2 to 4 hours or longer.

Stream Velocity Important

In its program of bridge and river bed inspection, the Delaware & Hudson recognizes that so many factors enter into the action of streams and rivers in the vicinity of bridges, that the frequency and extent of the inspections warranted or necessary at each bridge location present a study in itself. One of the principal factors which affects the scouring ability of a stream is the velocity of its current. Factors which affect the possible velocity of the current are the size, shape and character of the drainage area involved, the varying width and alinement of the stream bed, and its gradient.

Many other factors beside velocity enter into the action of streams, such as the size, quantity, specific gravity and hardness of the particles carried, and the quantity of such particles available for the stream to pick up under flood stage conditions. A careful study of all of these factors will assist in determining a basis for the frequency and extent of the inspections necessary at different locations.

All of the bridge and stream bed inspection work on the Delaware & Hudson is carried out under the general direction of the engineer, maintenance of way. The specific inspections in connection with the three important bridges across the Susquehanna river near Wilkes-Barre, Pa., referred to in this article, have been carried out under the immediate supervision of M. J. McDonough, division engineer at Carbondale, Pa.

Motor Car Collides With Freight Train

A HEAD-ON collision between a motor car pulling an empty trailer and a freight train on the Wheeling & Lake Erie, at Unionvale, Ohio, on September 16, 1938, resulted in injuries to a section foreman and four laborers. According to the report of the Bureau of Safety, this accident resulted from failure to remove the motor car from the main track in time to clear the train, or to provide flag protection, because the foreman over-estimated the running time of the train after receiving a line-up.

Evidence developed at the investigation, as reported by the Bureau of Safety, indicated that the foreman obtained a line-up at Adena, 4.7 miles east of Unionvale, at 7:37 a.m., at which time two eastbound freight trains were approaching, No. 94 being at Jewett, 13 miles to the west; and No. 70, the train involved in the accident, near Leesville, 27 miles west of Adena. The motor car cleared No. 94 at Hurford, 2 miles west of Adena, left there at 8:10 a.m., passed Kenwood, 1.4 miles farther west, at 8:15 a.m. and collided with No. 70, 1.3 miles west of Kenwood, at 8:25 a.m.

This is a single-track line. Approaching the point of accident from the east there is a 2 deg. curve to the left, 628 ft. long, followed by a tangent 1,646 ft. long, then a compound curve, ranging from 30 min. to 3 deg., to the left. The accident occurred 487 ft. from the west end of the tangent. At Unionvale there is a spur track 374 ft. long, south of the main track, with a facing point switch for eastbound trains. The accident occurred 595 ft. east of this switch. The turnout is on the inside of the 3 deg. section of the curve, and the report states that a high-side gondola on the spur limited the view of both the engineman and motorcar operator to about 950 ft.

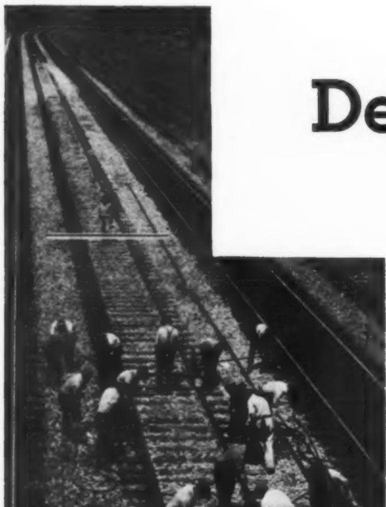
According to the Bureau's report, rules governing the use of hand, motor, velocipede and push cars on this road require that operators shall be examined as to their fitness to handle and operate cars by a qualified officer who will furnish each operator with a card indicating that a satisfactory examination has been passed. * * * This card, with a copy of the current time table and a standard watch, must be in the possession of each operator at all times when on duty. In addition, motor car operators are required to obtain line-ups before using the main tracks or, if this is impracticable, to protect by flagging where the view is limited.

In its discussion of the accident, the Bureau stated that according to the evidence, the section foreman involved in the accident had been examined on the rules for the operation of hand, motor, velocipede and push cars in 1925. These rules were revised in 1931, but he had not been examined on the revised rules or informed of their existence. At the time of the accident, he did not have a time table in his possession, none having been issued to him, although he was required by the rules to have one. He did not possess information that would enable him to arrive at a reasonably accurate estimate, rather than a mere guess, of the running time of the train.

According to the interpretation of the revised rules by the officers of the railway, motor cars were permitted to operate in accordance with information contained in the line-ups, but the interpretation was not uniform with respect to how long they were effective and the authority they conferred. The roadmaster stated that they are good only until the motor car is outside the car house; other officers gave a more liberal interpretation to the effect that flagging is not required where the line-up indicates that no train is near.

In discussing the time that the foreman should have allowed for No. 70 to reach Unionvale after the line-up was obtained, the report states that the officers of the road were not in agreement as to the proper estimate. However, as the foreman had no copy of the current time table and did not know the distance from Leesville, he was not able to make an estimate of this time interval; but assumed from previous experience that he had time to get in the clear on the Unionvale spur.

The Bureau concluded that this accident was caused by failure of a motor car to clear the main track for a freight train or to provide flag protection, on account of over estimating the running time of the freight train, and recommended that the responsible officers of the road adopt a method of operating motor cars that will provide more definite safeguards, and that both the employees engaged in such operation and the officers be thoroughly instructed relative thereto.



The Track Has Been Kept Safe, But the Majority of Roads Reported Much Deferred Maintenance Work

Deferred Maintenance— How Much?

I.C.C. Sets Figure at $283,820,066 for Both Fixed Property and Equipment, Based on Estimates Received From 115 Roads— 48 Roads Report No Deferred Work

FORTY-EIGHT railways claim no deferred maintenance of roadway or equipment, while 67 railways have work undone in varying amounts up to $75,000,000 and the total accumulation for the railways of the United States as a whole aggregates $283,820,066. These are the surprising deductions to be drawn from returns made to the Interstate Commerce Commission in reply to a questionnaire, and made public by the Bureau of Statistics of the Commission late in March.

In this questionnaire, the first and most important question read as follows:"How much would it cost to put the respondent's railway in what it considers a normal condition to handle a volume of traffic in 1939 equal to that actually experienced for the calendar year 1937, that is, to make good deferred maintenance which has accrued to December 31, 1938?" Under this question, divided between expenses for materials and equipment, and charges for wages, were items relative to rail renewals; tie renewals; other roadway and track maintenance work, including fences; bridges and elevated structures; stations, office buildings and station facilities; shop buildings, enginehouses, and appurtenances; all other maintenance of way and structures work; shop machinery and tools; locomotives and cars (repairs and additional equipment); and all other repairs to or purchases of equipment.

Of five other questions included in the questionnaire, No. 2 dealt with the amount of the deferred maintenance that must be made up at once, and during the next three years. Question No. 3 inquired concerning necessary expenditures for deferred maintenance to prepare for traffic 10 per cent greater than that of 1937, while Questions Nos. 4 and 5 had to do with the requirements of the railways during the next three years for additions, betterments and extensions on the basis of 1937 traffic and a 10 per cent increase thereon. Question No. 6, referring to Nos. 4 and 5, called for outstanding examples of how the increased capital expenditures suggested would help reduce the cost of rendering transportation service in excess of the added interest charges involved and amortization of the new capital.

The total number of replies received in time for tabulation in the report was 115, many of these being for systems covering a group of individual roads. The revenues of these roads amount to 99.75 per cent of the total revenues of the Class I railways. The answers from 48 roads indicated that these roads have no deferred maintenance in roadway, structures and equipment, while replies from 67 roads reported deferred maintenance over a widely varying range.

Data Summarized

On the basis of answers to Question No. 1, the railways reported that at the close of 1938 there was totaled deferred maintenance in their properties, including tracks, structures, locomotives and cars, and all types of roadway and shop equipment, amounting to $283,820,066, assuming a traffic as large as that of 1937 to be in prospect. Summarizing the other data received from the railways, it is indicated that $495,757,106 should be expended during the three-year period 1939-1941, or $165,252,369 annually, for additions, betterments and extensions to enable the carriers to handle traffic more cheaply and expeditiously. These amounts, aggregating $779,577,172, which it should be understood are for locomotive and car as well as roadway and structures items, are in excess of any amounts to be spent for normal maintenance, and have no relation to any sums which may be required to meet maturing obligations incurred in the past.

According to the report, a statement including more than 100 typewritten pages, all of the deferred maintenance reported by the railways need not be made up in the next three years, it being pointed out by the roads in their replies that $221,027,268, or $73,675,756 annually, would take care of their requirements for equipment and roadway and structures during these three years. Adding this annual amount to the annual requirements stated for additions, betterments and extensions, gives the sum that railway officers say they should spend each year for the next three years above normal maintenance requirements, assuming a traffic equal to 1937. This amounts to $238,928,125, or a total of $716,784,374 for the three-year period. Reflecting comments received from the roads questioned, the report states that the above total of $716,784,374 must be taken as conservative, as obviously, it does

not represent all of the work railway officers would like to undertake "if they had the money" to bring their properties to a high standard.

If Traffic Increases

According to the answers received to Question No. 2, relative to the requirements of the railways to cover deferred maintenance on the assumption that traffic in 1939 will exceed that of 1937 by 10 per cent, the roads feel that the figures given above should be increased $94,851,730, bringing the total estimate to $378,671,796. In addition, such increase in traffic would, according to railway officers, increase the amount necessary for additions, betterments and extensions by $19,990,825, or to $515,747,931 for the three-year period.

Summarizing these figures, it appears that if all the deferred maintenance in fixed property and equipment reported were to be made up in the three-year period under consideration, and that if traffic should average 10 per cent larger than in 1937, the total amount of money that the railways could use above normal maintenance requirements in this period would be $894,419,727. Divided equally, this would be $298,139,909 a year for each of the three years.

Of the 67 roads which reported deferred maintenance in equipment and fixed property as of the first of 1939, 44 were not in the hands of the courts and 23 were in receivership or trusteeship. The railways not in the hands of the courts reported deferred maintenance amounting to $213,117,350, which was 9.701 per cent of their operating revenues for 1937, while those roads in receivership or trusteeship reported deferred maintenance of $70,702,716, equal to 14.068 per cent of their operating revenues.

Among the roads reporting no deferred maintenance in fixed property and cars and locomotives, and no special requirements for additions and betterments, were the Bangor & Aroostook; the Chicago, Milwaukee, St. Paul & Pacific; the Missouri-Kansas-Texas; the Northwestern Pacific; the St. Louis-San Francisco; the Seaboard Air Line; the Union Pacific (including lines leased by this road); and the Virginian.

Amount Reported Varies

Among the roads which reported deferred maintenance, the amounts reported varied from as little as a few thousand dollars to a maximum of more than $75,000,000. The amounts reported by these roads, including deferred maintenance in equipment as well as in roadway and structures, are given in one of the accompanying tables, which also indicates the amounts that these roads should spend for additions, betterments and extensions, (equipment and fixed property) during the next three years in the event of traffic equal to that of 1937. Another table included summarizes by general accounts the deferred maintenance reported by the roads, divided essentially between expenditures for material and equipment and labor.

Special Comments of Several Roads

To aid one in appraising the returns made by individual roads, the Commission submitted with its report quotations from comments made by a number of the roads with their returns. Typical of these, especially as they refer to deferred maintenance in roadway and structures, are the following:

Atchison, Topeka & Santa Fe: Our plant and equipment are now in condition to handle in 1939 the traffic volume of 1937 with the safety and efficiency of 1937, with no expenditures for maintenance in excess of those for current requirements, except as to equipment (locomotives and cars). However, if the same traffic volume should develop in 1939 as prevailed in 1937, with increased earnings, rail and tie renewals and other maintenance work would, undoubtedly, be increased substantially.

Baltimore & Ohio: The properties of this company have been maintained in condition to assure safe and adequate service for the business handled. It is not imperative that the entire amount shown in answer to Question 1 ($25,837,592) be available at once. The apportionment of this estimated amount would depend largely on the volume of traffic and whether there is a rapid and sustained increase.

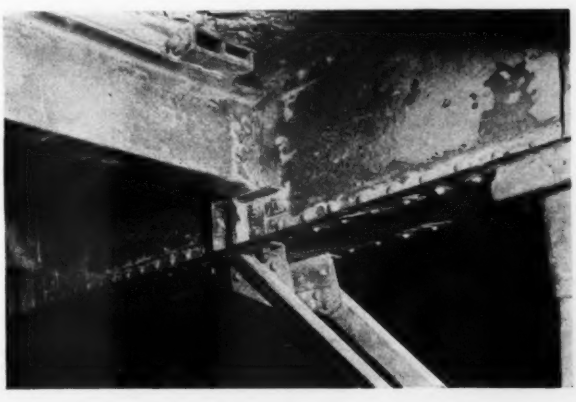
Boston & Maine: There is no deferred maintenance on the property affecting the safety of operation in any way. A volume of traffic equal to that of 1937, or even 10 per cent greater, can be handled without any appreciable increase over the actual expenditures for maintenance of way and structures in 1937. However, if money were available, an additional expenditure of $2,500,000 to $3,000,000, spread equally over the next three years, would bring about decreases in maintenance expenditures in the future.

Chicago & North Western: Current expenditures during the last few years and those contemplated in the year 1939 have been of such character and in such amounts as to keep the property adequately maintained for such operations as it had been conducting. It is thought that the 1937 volume of traffic could be handled without any substantial enlargement of the program, so far as maintenance is concerned. In other words, there is no deferred maintenance that, unless made up, would prevent the handling of such volume, and neither would it prevent such traffic being handled expeditiously, make the cost of handling it excessive, or cause serious damage to the property. What has occurred is that a normal and advisable improvement program was completely arrested and has been at a standstill for several years. Therefore, an extensive program of betterments would be advisable if adequate funds were available.

Chicago, Milwaukee, St. Paul & Pacific: Properties are in good shape and no special rehabilitation funds are required. However, if the volume of traffic in 1939 should increase 10 per cent over that of 1937, the sum of $500,000 should be expended for rail and ballast maintenance, and $5,000,000, for new freight cars.

Chicago Great Western: Expenditures listed ($2,512,984) represent the money needed to be spent to put the property in first-class condition, irrespective of the amount of traffic handled. Most of the work can be deferred for five or six years.

Louisville & Nashville: After



Bridges Have Been Maintained in a Serviceable Condition, But Much Painting Has Been Deferred

Analysis of Deferred Maintenance by Accounts

	Expenses for material or equipment at prices current at the time of this reply	Charges on respondent's payroll at wage rate current at the time of this reply	Other expenditures	Total	Amount of preceding total which would be charged to Investment
(a) Rail renewals	$ 43,313,146	$ 6,144,630	$ 637,094	$ 50,094,870	$ 9,597,745
(b) Tie renewals	16,280,095	4,734,274	94,516	21,108,885	43,750
(c) Other roadway and track maintenance, including fences	13,393,976	23,475,158	1,326,683	38,195,817	5,228,700
(d) Bridges and elevated structures	8,196,381	7,224,742	2,351,796	17,772,919	6,481,737
(e) Stations and office buildings, and station facilities	2,146,152	2,553,145	1,212,184	5,911,481	516,497
(f) Shop buildings, engine-houses, and appurtenances	2,877,367	3,115,153	80,955	6,073,475	1,200,941
(g) Shop machinery and tools	2,904,686	603,424	65,573	3,573,683	1,995,907
(h) All other maintenance of way and structures	6,272,333	6,928,856	1,329,781	14,530,970	3,105,345
(i) Locomotives and cars:					
(1) Repairs and existing equipment	48,069,887	31,484,807	4,618,225	84,172,919	12,717,653
(2) Additional equipment	31,681,708	927,700	4,666,400	37,275,808	37,061,808
(j) All other repairs or purchase of equipment	2,959,264	919,975	1,230,000	5,109,239	1,795,047
Total	$178,094,995	$88,111,864	$17,613,207	$283,820,066	$79,745,130

pointing out the difficulty of determining a "normal" standard of maintenance, the return says as to the deferred maintenance figures given ($2,103,800 total), as follows: "The figures given are nothing more than a guess to attain a standard of maintenance reasonably satisfactory, yet falling far short of a desirable standard and somewhat above a standard of safety alone. They imply no undermaintenance so far as the handling of present traffic safely is concerned, nor the desirability of raising the standard of maintenance under the existing outlook for the railway industry; they are much short of the amount necessary to bring the property to a high engineering standard."

New York Central: With respect to deferred maintenance of its fixed property, this road commented as follows: "The New York Central System has been maintained in a condition to handle safely, economically and without delay the fluctuating volume of traffic carried in recent years; is now in condition to so handle the present level of traffic; and with an appreciable increase in current maintenance will be in condition to handle a traffic volume equal to that in 1937, or 10 per cent in excess thereof.

Northwestern Pacific: This road reported that normal maintenance would suffice to handle a volume of traffic equal to that of 1937, but that there are numerous items of maintenance that are desirable if money becomes available, such as painting, additional ballast, ditching, mowing of the right-of-way, etc.

Pennsylvania: The Pennsylvania and the Long Island are now in condition to handle safely, expeditiously and economically the traffic of 1937, or traffic in excess thereof by 10 per cent, it being understood that any increase in traffic will be met by an increase in current maintainance.

From 1932 to 1936, due to a decline in traffic, some maintenance was deferred, but not to an extent affecting safety or expeditious and economical operation. The deferment was substantially in structures not vital to safety or economic operations, such as the painting of buildings, care of right-of-way and station grounds, and betterment work to provide for possible increases in traffic. Also, rail, tie and ballast renewals were cur-

Buildings Have Been Among the Most Neglected Facilities on the Railways

tailed, and maintenance of property temporarily out of use was postponed. During the year 1937, through increased track maintenance and repairs to structures, and increased efficiency, deferred maintenance was arrested, but with the low volume of traffic in 1938 there was some further deferment of work.

Southern Pacific: As of the end of 1938, the property was in a normal condition of maintenance viewed from the standpoint of safety, adequacy and modern operation. This does not mean that there are not numerous items of maintenance that are desirable, for which expenditures would be made if the money were available for the purpose. Such items consist generally of the maintenance of buildings of all kinds, especially painting; ballast to provide full ballast sections; ditching; mowing of the right-of-way; and many other items of a similar nature.

Texas & Pacific: The physical property of the Texas & Pacific was never in better condition and requires no maintenance expenditures that cannot be met out of operating revenues. It can handle economically a 10 per cent increase in the volume of the traffic of that year within expenditures contemplated for 1939.

Union Pacific (and leased lines): It will not be necessary to make expenditures in excess of normal to handle in 1939 a volume of traffic equal to that experienced in 1937 or 10 per cent in excess thereof.

Commenting upon the replies received from the different roads relative to deferred maintenance, the report of the Commission said, in part, as follows:

"It is evident from the returns that however acute the financial condition of the railways may be from the standpoint of net returns to the investor, the physical condition of the carriers generally is good in matters affecting the safety of train operation, and that their facilities are adequate for handling immediately prospective traffic. This is not incompatible with the view that a sharp rise in traffic and revenues would result in greatly increased maintenance expenditures, partly because of the direct effect of the increase in traffic, and partly because the standard of what is necessary or desirable would be raised."

Testimony in Recent Rate Cases

As if to check the data received concerning deferred maintenance through its recent questionnaire, the Commission submitted as a part of its report evidence as to deferred maintenance presented before it by railway representatives in both the General Rate Level investigation of 1933 and the fifteen per cent case in 1937-38, when these representatives were calling attention to the need for additional money to permit adequate maintenance of their properties.

Summarizing the evidence in the former case, the Commission said, in part, as follows:

"The drastic decline in expenditures

for maintenance is partially explained by declining traffic and by lower wages and prices of materials and supplies. But, while the carriers' properties have generally been maintained in a condition safe for operation, there is a large amount of under-maintenance, even if traffic should continue permanently on a basis substantially as low as that of 1932. With a revival of traffic only to a level of 1924, in which year freight was lower than that of any year in the five-year period 1925-1929, a very large amount of under-maintenance would have to be made up. Respondent's witnesses estimate that at the present rate of maintenance at the end of 1933, with traffic no greater than in 1932, the accumulative deferred maintenance in the Eastern district (including the Pocahontas region) will be approximately $200,000,000, and in the Western district $90,000,000. On the basis of average traffic in the years 1927-1931, the carriers estimate deferred maintenance at the end of 1933 as about $330,000,000 in the Eastern district and $210,000,000 in the Western district. No maintenance estimates were presented for the Southern region. If this is taken into account, the preceding estimates indicate that on the railways of the country as a whole at the present time there is an accumulated under-maintenance of something in excess of $300,000,000 on the basis of 1932 traffic, and something over $600,000,000 if the traffic of the years 1927-1931 be taken as normal."

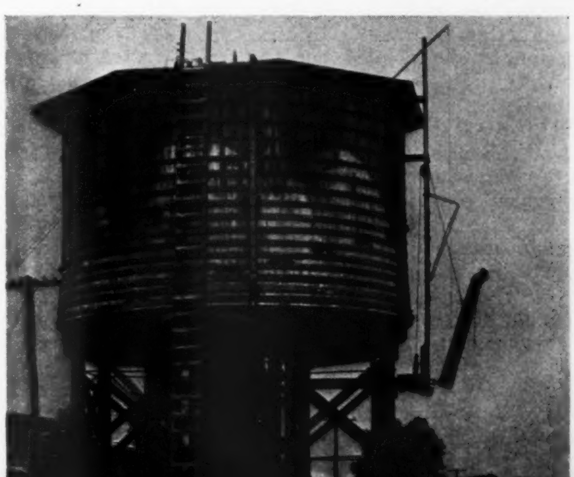
In the testimony of railway executives in the Fifteen Per Cent case, late in 1937, according to the report, Ralph Budd, president of the Chicago, Burlington & Quincy, testified that although his property had been maintained in splendid condition, there had been a smaller than normal number of tie insertions and of tons of rail laid, and, he added, that in the future, it is very desirable that these deficiencies be corrected. Continuing, he discussed the large opportunities for economies from improvements in cars, locomotives and fixed property, and it seemed to him that expenditures for these items on the railways of the country "might," when resolved into money, amount to $900,000,000 a year.

In the same case, M. W. Clement, president of the Pennsylvania, pictured that road as having been in the pink of condition and efficiency in 1929 but said that in 1931 and 1932

Deferred Maintenance and Additions and Betterments by Railways or Systems

Railway or system	Total deferred maintenance Question 1	Expenditures reported for additions, betterments, and extensions 3 year total Question 4
Akron, Canton & Youngstown*	$ 186,327	$ 602,037
Alton	3,232,372	....
Ann Arbor	1,250,000	120,000
Atchison, Topeka & Santa Fe	3,000,000	....
Atlanta & West Point§	9,942	....
Atlantic Coast Line	3,747,045	4,631,862
Baltimore & Ohio	25,837,592	....
Bessemer & Lake Erie	....	8,056,950
Boston & Maine	1,667,000	8,400,000
Canadian National Lines in New England	....	315,000
Central of Georgia*	4,543,100	1,174,595
Central of New Jersey	4,874,814	300,000
Central Vermont	195,000	225,000
Charleston & Western Carolina	183,511	60,000
Chesapeake & Ohio	....	4,565,000
Chicago & Eastern Illinois*	424,000	1,650,000
Chicago & North Western*	....	26,952,800
Chicago, Burlington & Quincy	518,110	30,000,000
Chicago Great Western*	2,512,984	....
Chicago, Indianapolis & Louisville*	837,157	5,247,984
Chicago, Rock Island & Pacific*†	5,717,000	46,950,000
Chicago, St. Paul, Minneapolis & Omaha	....	15,261,858
Clinchfield	88,250	246,000
Columbus & Greenville	1,820,103	
Delaware & Hudson	3,027,792	15,593,698
Delaware, Lackawanna & Western	2,091,800	5,250,000
Denver & Rio Grande Western*	5,115,489	22,293,200
Denver & Salt Lake	2,466,530	1,817,322
Detroit & Mackinac	488,944	....
Detroit & Toledo Shore Line	247,529	102,000
Detroit, Toledo & Ironton	1,125,550	586,400
Duluth, Missabe & Iron Range	....	4,320,000
Duluth, South Shore & Atlantic*	1,818,037	262,883
Duluth, Winnipeg & Pacific	....	51,000
Elgin, Joliet & Eastern	....	8,900,000
Erie (including Chicago & Erie)*	5,102,801	13,690,419
Florida East Coast*	4,829,750	2,212,500
Georgia, Lessee Organization	99,792	78,087
Georgia & Florida*	486,294	....
Grand Trunk Western	....	3,359,000
Great Northern	....	5,700,000
Gulf Coast Lines (including subsidiaries)*‡	....	3,026,000
Gulf Mobile & Northern	937,125	....
Illinois Central††	5,050,000	17,680,000
International-Great Northern*	....	2,902,000
Kansas City Southern	258,000	1,560,000
Lehigh Valley	1,634,255	600,000
Long Island	2,908,000	6,226,600
Louisville & Nashville	2,103,800	48,979,000
Maine Central	2,138,500	221,274
Minneapolis & St. Louis*	2,943,395	750,000
Minneapolis, St. Paul & Sault Ste Marie*	10,688,755	2,973,820
Mississippi Central	1,109,018	....
Missouri & Arkansas	454,800	75,000
Missouri-Illinois*	....	1,051,000
Missouri Pacific (including subsidiaries)*	....	20,625,000
Mobile & Ohio*	3,238,140	....
Monongahela	736,403	116,000
Nashville, Chattanooga & St. Louis	1,543,284	6,990,000
New York Central‡‡	32,934,844	10,500,000
New York, Chicago & St. Louis	105,000	10,466,622
New York, New Haven & Hartford*	2,646,000	....
New York, Ontario & Western*	1,456,300	655,000
Norfolk & Western	....	11,007,900
Norfolk Southern*	26,000	945,276
Northern Pacific	....	18,000,000
Pennsylvania	75,091,300	26,850,000
Pennsylvania-Reading Seashore Lines	3,009,340	2,699,100
Pere Marquette	1,300,000	14,742,000
Pittsburg & Shawmut	462,832	272,208
Pittsburgh & West Virginia	2,590,876	502,000
Pittsburg, Shawmut & Northern*	545,460	105,999
Reading	6,336,373	2,062,965
Richmond, Fredericksburg & Potomac	838,500	1,065,000
Rutland*	684,400	....
St. Louis Southwestern*	4,300,566	6,404,888
Southern†††	3,532,000	3,300,000
Southern Pacific Co.—Pacific Lines‡‡‡	....	10,521,900
Spokane, Portland & Seattle and Affiliated Companies	....	900,000
Tennessee Central	1,249,000	1,159,551
Texas & Pacific	....	1,888,100
Texas Mexican	695,723	....
Toledo, Peoria & Western	....	4,000,000
Wabash*	10,304,259	3,705,000
Western Maryland	8,142,325	1,500,000
Western Pacific*	1,046,502	8,462,308
Wheeling & Lake Erie	3,234,376	1,290,000
Total	$283,820,066	$495,757,106

*Denotes road in receivership or trusteeship.
§Includes Western Ry. of Alabama.
†Includes Chicago, Rock Island & Gulf Ry. Co.
‡Includes Beaumont, Sour Lake & Western Ry. Co.; New Orleans, Texas & Mexico Ry. Co.; San Antonio, Uvalde & Gulf R. R. Co.; St. Louis, Brownsville & Mexico Ry. Co.
††Includes Illinois Central R. R. Co.; Gulf & Ship Island R. R. Co.; and Yazoo & Mississippi Valley R. R. Co.
‡‡Includes New York Central R. R. Co. and leased lines; Pittsburgh & Lake Erie R. R. Co.
†††Includes Alabama Great Southern R. R. Co.; Cincinnati, New Orleans & Texas Pacific Ry. Co.; Georgia Southern & Florida Ry. Co.; New Orleans & Northeastern R. R. Co.; Northern Alabama Ry. Co., and Southern Ry. Co.
‡‡‡Includes Texas & New Orleans R. R. Co.



Water Service Facilities on Many Roads Have Not Received the Attention They Should Be Given

expenses were eliminated as fast as business decreased. He then referred to the testimony which he gave in May, 1933, to the effect that the deferred roadway and equipment maintenance on eastern roads was more than $500,000,000. "Since that time," he said, "I have seen little of this deferred maintenance made up by repairs," but he added that so far as the Pennsylvania was concerned, the deferred maintenance had been made up slightly and capacity maintained by capital expenditures and improved transportation methods. Referring to the needs of his particular road, he stated that it would require $20,000,000 to make up the deferred maintenance of cars, $2,000,000 to bring power to normal, with other improvements that would require an expenditure of $29,000,000. Continuing, he said that the accumulation of deferred maintenance in rail and track was still more than $40,000,000, with another $40,000,000 required for additions and betterments.

At the same hearing on the Fifteen Per Cent case, Charles Donnelly, president of the Northern Pacific, which road reported no deferred maintenance in roadway, structures or equipment in the recent questionnaire, testified to the effect that during the depression, supervision and maintenance were cut to the minimum consistent with safety, and that the accruals of maintenance for equipment and fixed property were not built back into the property currently. "Eventually," he said, "these units must be replaced to avoid an abnormally large program at some future date, so that there is deferred maintenance. There is no possible question about that. We have failed to keep up our equipment. We would have kept it up had conditions been normal or even anything approaching normal." In the same testimony, he pointed out that the budget of his operating department for 1938, which had amounted to $11,000,000, was cut to $2,850,000 by the Board of Directors.

At the same hearing, J. B. Hill, president of the Louisville & Nashville, stated that maintenance on his road had been adequate during recent years but not generously adequate. "Every operating officer," he said, "would like to see many things done in maintenance that have not taken place."

Speaking for the Southern Pacific, Hale Holden, its president, called attention to the great decline in maintenance expenditures since 1929, but remarked, "Fortunately, the Southern Pacific track is in good, sound condition, and we can live on the fat for a little while; but no railroad can do that very long without accumulating an undesirable situation. It ought not to be incurred."

Daniel Willard, president of the Baltimore & Ohio, stated that track conditions on his road were adequate for present requirements, but estimated that the operating expenses of the B. & O. over a period of time would be higher than normal "because the condition of the property is lower than normal." He estimated that for two, three or four years, operating expenses might be three or four points, maybe more, above what they would normally be "while we are catching up with this deferred maintenance."

Speaking for the New York Central, F. E. Williamson, its president, explained that in recent years it had been necessary to defer much work which would have been done if funds had been available, but pointed out that most of this deferred work was on branch lines with minimized requirements, and that such maintenance work as had been done had been concentrated on the important lines.

Summarized Testimony

Summarizing all of the testimony brought before it in connection with the Fifteen Per Cent case, the Commission said with regard to the apparent needs of the roads in connection with maintenance of way and structures, in part, as follows:

"When the depression began to be felt severely about 1931, expenditures for maintenance of way and structures were reduced to the minimum. There were no immediate ill effects from this reduction because of the high standard of maintenance which prevailed prior to the depression, but that compensating factor has largely disappeared. During the period of recovery in railroad traffic and earnings since 1932, maintenance continued to be governed mainly by immediate needs, depending on the volume of traffic. A year or so ago, when the outlook seemed more encouraging, a number of roads expanded their maintenance programs, but curtailed them again sharply in the latter part of 1937 when operating costs increased and traffic declined. The cumulative burden of deferred maintenance dating from the depression, therefore, is still present. One eastern executive estimated this burden on the Eastern district as nearly $500,000,000, measured in terms of money, only little less than in 1933. Deferred maintenance of structures appears to be particularly extensive."

Cotton Belt Proves Versatility of the Tractor

IN A single year of service a crawler tractor may well be called upon to perform a wide variety of tasks, if the experience of the St. Louis Southwestern can be considered typical. Early in 1937 this road purchased a Caterpillar RD-6 Diesel-powered tractor of 75-in. gage, and, as attachments, a Caterpillar No. 44 grader, hand-controlled, with scarifier, an R6 X hydraulic-operated road builder, a Killefer 36R revolving scraper with a capacity of 57 cu. ft., and a John Deere tractor-mower with a 7-ft. cutting bar. Since their arrival, these machines have been in almost constant service.

Bank Widening and Ditching

The equipment was first assigned to a project of bank restoration and ditching on the Paragould & Southeastern branch, which extends southeast from Paragould, Ark., to Blytheville. On this job the tractor and the grader, working alongside teams most of the time, were found both to be an effective combination in themselves and also to increase the production of the teams at least 30 per cent. When working with the teams, the combination showed by comparison that it could loosen dirt much more satisfactorily than plows.

The tractor and grader were sometimes sent ahead of the teams to break ground and open up drainage outlets, and, by getting rid of a considerable amount of water and by loosening rocks and roots, they prepared the ground for much better and faster work by the teams. At other times the tractor-grader outfit was assigned to follow the team work, finishing the job. With this equipment, dressing was done more

smoothly, cheaply, and rapidly, especially in the right-of-way ditches, than could be done by fresnos and slips. Along stretches of track where the drainage was poor or where only a small amount of bank restoration

Crawler-Mounted Units of the Larger Sizes Are Also Finding Wide Application in Railroad Service

was required, the tractor and grader did the work alone. In the vicinity of Blytheville, where the right-of-way is narrow, the equipment was also used alone to good advantage.

Used With Dragline

Upon the completion of the branch line work, the tractor and its accessories were transferred to the main line between Jonesboro and Gilkerson, Ark., where the tractor was employed in conjunction with a Bucyrus-Erie crawler-mounted dragline in the relocating of a ditch farther away from the roadway embankment. The problem at this point consisted of filling the existing ditch with material excavated in digging the new ditch with the dragline bucket; constructing a small levee on the back side of the new ditch; and smoothing up the finished job with the grader. Since both the operator and the oiler of the dragline were qualified to handle the tractor and its auxiliary units, a separate operator was not required for this equipment on this job. This factor contributed materially to the estimated saving of 50 per cent over contract work, that was made possible by utilizing this equipment.

Many Operations at Pit

After completing the ditch relocation work, the tractor was taken to division headquarters at Pine Bluff, Ark., for minor repairs, and was then sent to the Bearden gravel pit south of Pine Bluff. Here, where the gravel was loaded into motor dump-trucks by a power dragline, and then hauled from one-third to one-half mile to a tipple for loading into cars, the tractor equipment was found invaluable for maintaining the truck roadway. This was true particularly because of severe weather conditions which prevailed, and the fact that loading was being done in the lowest part of the pit, which combined to make the roadway maintenance very necessary and especially heavy.

In addition to the road work at the pit, the tractor was employed effectively in moving the railway cars to and from the loading tipple, and, coupled with its auxiliary equipment, in ditching to drain water away from the truck loading points. It was also used to large advantage in removing surplus gravel at the loading machine and in preparing a roadway for long moves of the dragline, and showed itself to be particularly effective in stripping the surface vegetation and soil from over the gravel bed. The grader was generally employed for the road work but the bulldozer attachment was also used at times to very good advantage in this work, as well as in the stripping and clearing operations at the pit.

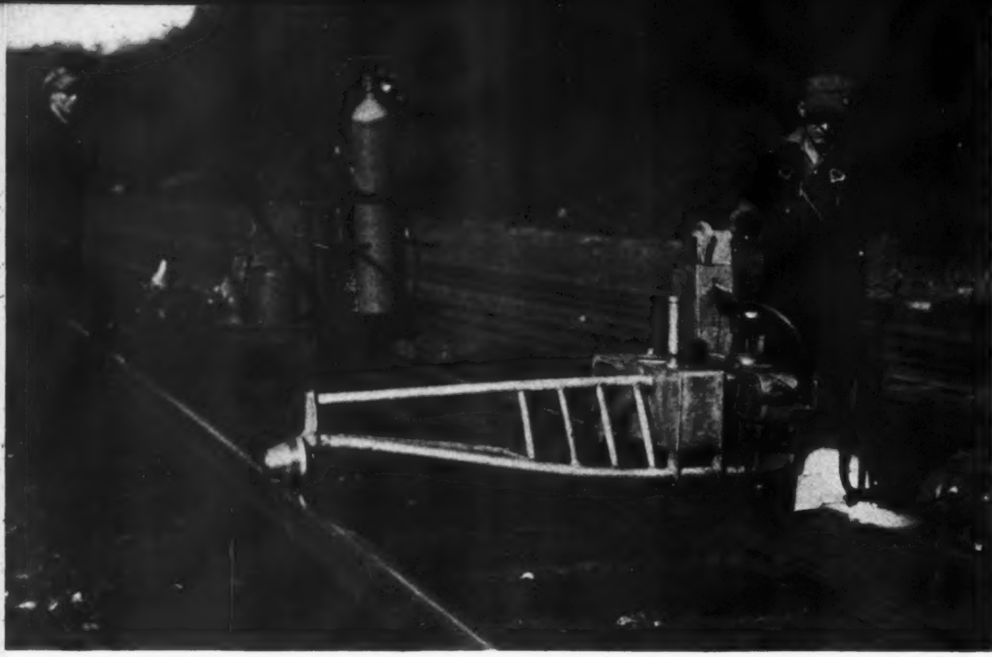
It is estimated that the use of the tractor and its accessory equipment at the pit stepped up the loading operation at least 40 per cent. With the aid of the equipment, more dirt and gravel were loaded with two trucks than had been loaded previously with three trucks. Moreover, because of the clean stripping work possible with the equipment, the Cotton Belt has been able to obtain the best gravel available, with a minimum of vegetation or dirt.

Other Uses

The revolving scraper auxiliary unit purchased by the road has not been used to a great extent as yet since the tractor has been employed almost continuously with the other earth-moving units. However, it has been used enough to demonstrate that it is a good earth-moving accessory and will be effective in both building embankments and in cleaning out cuts. The fact that it does not require a separate operator makes it unusually economical to operate. The mowing machine, a small one, was purchased primarily for use in connection with the operation of the other machines and not for general use in cutting vegetation. This small mower has been found effective in clearing the ground of growth in advance of the other machines, but it is felt that it would not be economical to use it for general right-of-way mowing.

The problem on the Cotton Belt has not been to keep the tractor equipment busy, because it is said that just as soon as it can be spared from operations such as already mentioned, it is planned to use it on a large amount of routine maintenance work. Experience has shown that the operating costs of the tractor are reasonable, and it is expected that the expense for maintaining it and its auxiliary equipment in good condition will be relatively small.

The Tractor and Grader Have Been Used Effectively in a Large Amount of Bank Restoration Work



With This Machine, the Entire End-Hardening Process Is Controlled Automatically

Rail End Hardening

on the Pennsylvania

This article describes the most recent practice on the Pennsylvania, involving the use of a fully automatic machine designed by F. M. Graham, assistant engineer of standards of that road. Through use of this machine, the end-hardening process is timed and controlled accurately in accordance with a predetermined standard, and the human element is eliminated, insuring a high degree of uniformity

VITALLY interested in prolonging the life of rails through the hardening of the ends to minimize end batter under wheel traffic, the Pennsylvania has developed a machine to carry out this class of work, (employing the oxy-acetylene flame and a water quench) with many unusual features, the most outstanding of which are its special interlocked mechanisms to permit the careful control of the work, and its almost completely automatic operation. Through its various features, every phase of the end-hardening process is timed and controlled accurately in accordance with a predetermined standard, and the human element is completely eliminated. As a result, all rail ends are treated with a high degree of uniformity as to extent of heat penetration and hardness, and the possibility of damaging the rail through overheating or burning is eliminated. At the same time, the machine is readily handled by a small force and requires a minimum of time to carry out the operations at each joint, with the result that it combines with its features of control and precision, large production and low operating costs.

Details of Machine

The fundamental operating features of the machine involve essentially the moving application of a predetermined amount of heat to the rail ends over a restricted area within a predetermined time interval, and then the automatic quenching of the heated area at the proper instant and over the proper period with an accurately calibrated quantity of water. Through these essential features, based on the hardness and grain structure desired, the temperature of the rail steel is raised through the critical range to the point desired, is then quenched through the critical range to a specific temperature, and then the draw is permitted under atmospheric conditions through the residual heat in the rail.

The machine itself is in essentially two parts, one, mounted on double-flanged wheels, directly over the rail being worked, which incorporates all of the heating, quenching, timing and operating mechanisms; and the other, an outrigger system of support to the opposite rail, so designed of tubular material as to become, in addition, a fundamental part of the quench water and torch cooling water systems. This latter part of the unit incorporates a five-gallon metal container, or reservoir, bringing the combined capacity of the water cooling and reserve system to approximately ten gallons. Throughout, the frame and the housings of the machine mechanisms are of aluminum, a feature which made it possible to keep the weight of the entire unit, exclusive of its water supply, down to approximately 200 lb. The over-all length of the machine is approximately 5 ft., while its over-all height above the track rail is about 3½ ft.

The operating unit of the machine consists of a compact assemblage of timing, water calibrating and operating mechanisms, which control the flow of gases to the heating torch, oscillate the torch backward and forward over the rail head area being treated at a uniform rate and through a predetermined period, and then cause the measured water quench at the proper instant. All of these operations are governed by one manual operation—the turning of a crank handle, as will be mentioned in greater detail later.

Special Heating Torch

As they affect the actual rail end hardening, the fundamental features of the machine are the special heating torch with its cooling system, the quenching water system, and the timing mechanisms. The torch, which projects out ahead of the main body of the machine and is supported by a movable carriage, has 11 openings staggered in two lines across its width. An important feature of the torch is that it is water cooled, and is integral with the quenching head, although the two water systems involved are entirely separate at this point.

The cooling water, in a circulating system, moves through the torch head and then back through the tubular outrigger frame which acts as a heat radiator. The quench water, on the other hand, while taken from the cooling water supply, is first carefully measured and is then fed to the quenching head through an entirely separate pipe system. In this latter system, a mechanically-operated pump forces the quench water into a graduated measuring glass on top of the machine, the capacity of which is set, as desired, by regulating the height of an adjustable overflow pipe. The charging of the measuring glass takes place automatically during the rail heating operation, and the timing trip in the operating mechanism discharges the quench water simultaneously with the cutting off of the heating flame at the end of the heating period.

The quenching head, integral with the torch head as already mentioned, consists essentially of three connected water manifolds placed side by side across the width of the rail head, and projects approximately two inches forward and backward from the transverse center line of the torch head. Each of the manifolds has 8 openings, providing a total of 24 water discharges from the quenching head, spaced uniformly over the heated rail end area.

Automatic Operation

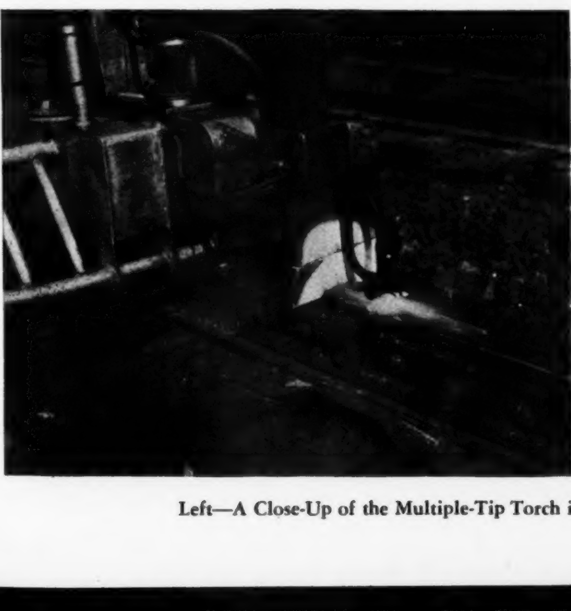
The only manual operations involved in rail end hardening with the machine are the spotting of the torch head centrally over the gap between rail ends, the clamping of the machine to the rail by pressing a foot pedal, and the engaging and operating of the hand crank at the top rear of the machine in a steady circular movement. All other operations through the completion of the quenching operation are entirely automatic, the next move of the operator being to release the rail clamp and to push the machine to the next joint.

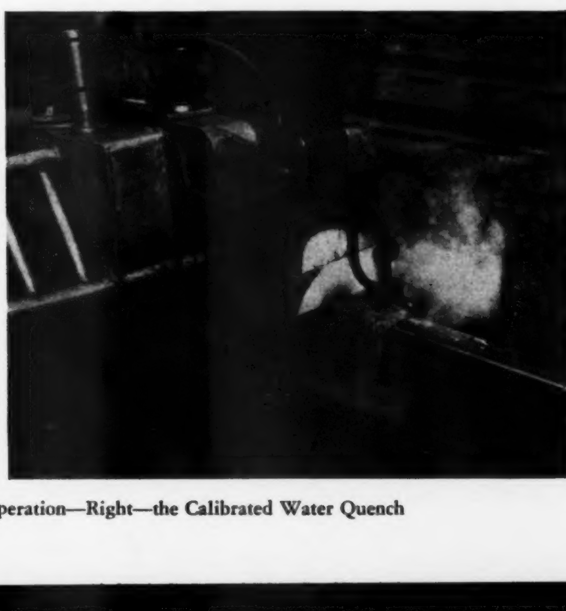
With the engaging of the hand crank and its first movement, a whole series of operations begin and are subsequently carried through to completion, regulated by means of the timing devices provided. For example, with the start of the crank, the gas valves are opened automatically and the gas at the torch is ignited by the spark from a spark plug. At the same time, the torch begins oscillating forward and backward over the rail ends within the prescribed limits; the water pump begins to operate circulating the cooling water through the torch and filling the measuring glass; and all timing devices are set in motion and are kept wound.

The principal timing device, which is set to the number of minutes and seconds prescribed for the heating operation, trips automatically at the end of the prescribed heating period and, in so doing, completely reorganizes the functions of the machine automatically. Immediately after the timing device trips, the hand crank is thrown out of engagement, the torch head is brought to a centered location over the joint, the gas valves are shut off, a clock indicating visually the length of the heating period is stopped, and the quench water is released—all simultaneously and automatically. It is then necessary only for the operator to stand by for the few seconds required for the quench water to discharge itself, and then, upon releasing the rail clamps, to move the machine forward to the next joint.

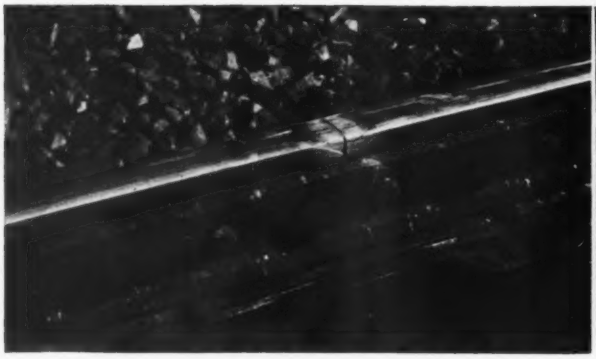
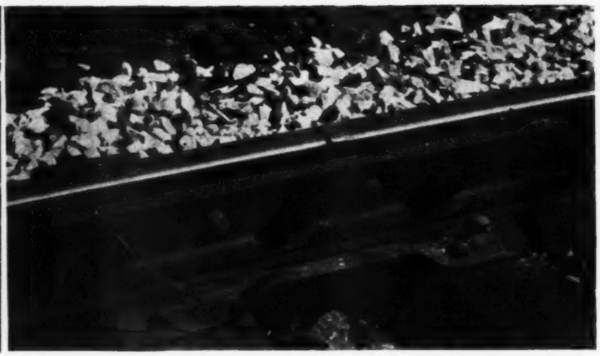
Special Safeguards

If during the manual cranking operation the operator should stop the movement of the crank handle, which would cause uneven heating or overheating of the rail if not guarded against, the gas supply to the torch is cut off automatically, extinguishing the flame. If this should occur, it is necessary for the operator to disengage the crank and start the sequence of heating opera-





Left—A Close-Up of the Multiple-Tip Torch in Operation—Right—the Calibrated Water Quench

Left—A Joint, Immediately After the Rail Ends Had Been Hardened—Right—More Than 60 Million Tons Had Passed Over These Hardened Rail Ends at the Time This Photograph Was Taken

tions over, but the clock mechanism of the machine indicates to him just how many additional seconds of heating are required.

The only auxiliary work of any character necessary on the rail in connection with the machine operations of end hardening includes the top grinding of the adjacent ends of new rail to remove any differences in height, the cross-grinding of the rail ends, and the packing of the expansion gap between rail ends with a plastic refractory material to prevent the possible overheating of the extreme top edge of the rail head and improper distribution of the heat to the rail head through the joint opening during the heating process. The grinding operations are carried out prior to and independent of the rail hardening work, but the application of the refractory material in the joint gap is done as a distinct part of and immediately ahead of the end-hardening work. In this latter operation, a man with a blade merely fills the expansion gap with the refractory compound to a depth of approximately 1/4 in.

The gas supply arrangement for the operation of the end-hardening machine depends upon whether the machine is used singly or in multiple. If used singly, the gas supply for each machine, consisting of two manifolded acetylene cylinders and one oxygen cylinder, can be transported on a track dolly. If used in multiple, which is the most effective and economical, the gas supply for all the machines can be carried along on a push car.

All of the elements involved in the rail end hardening with this machine on the Pennsylvania, including, the mixture and pressure of the gases used, the length of the heating period, the length of the torch stroke, and the volume of quench water used, are predicated upon careful studies made in the road's laboratory at Altoona, Pa., to bring about the precise rail end conditions desired. In these studies, numerous rail ends were hardened under varying conditions and the results were carefully analyzed. The machine was then calibrated and put in service, and has already hardened many miles of rail ends in track, both new and worn. With the torch flame and heating period constant, the extent of the quench carefully calibrated, and the human element entirely removed, the quality of the work done is known to be highly uniform.

Production and Force

Aside from the actual time required in heating the rail ends, the only other time involved in the end hardening operation is the quenching time, which amounts to approximately 15 sec., and the time required to move between joints. Thus, allowing four minutes per joint, the theoretical capacity of the machine, without interruptions by traffic, is 150 joints in 10 hr. Carrying out the work under traffic on the Pennsylvania, the daily production of the machine has varied widely with the volume of traffic, ranging from 70 to 116 joints in an 8-hr. period.

This machine was designed by F. M. Graham, assistant engineer of standards, and was built at the road's Altoona laboratory. It is being operated under the general direction of Robert Faries, assistant chief engineer, maintenance, of the system, and under the immediate direction of the engineering officers of the regions on which it is being employed.

Switch Point Guards for Turnouts in Yards*

By F. J. Bishop
Engineer Maintenance of Way, Toledo Terminal, Toledo, Ohio

YARD maintenance offers a number of problems that are in many respects similar to those encountered in the maintenance of main tracks, but that have no exact parallel with those encountered elsewhere than in the yards themselves. One of these is the wear on switch points and stock rails. On main tracks, with few exceptions, traffic largely follows the through route, turnout movements being in the low minority; in yards, especially on ladders, this is reversed and movement through diverging routes preponderates, thus creating a condition with respect to wear on the switch points that differs from main-line movements. To retard the wear that occurs on the switch points in yards, we have been using switch point guards and from our experience we believe that their application is fully warranted at points of heavy traffic.

The following types of protective devices or guards for switch points are available at present: (1) a standard short guard rail installed between the running rails in the same manner as a frog guard rail; (2) short guards made of manganese steel, placed on the outside of the running rail, and

*This discussion was submitted for publication in a previous issue, in answer to a question whether there is any advantage in the application of switch-point guards to yard turnouts. Owing to its scope it was withheld for presentation here as an independent article.

functioning like the self-guarded frog; (3) manganese-steel switch-point protectors bolted to the inside of the rail, contacting the head and web of the rail; and (4) switch protectors welded on the gage side of the head of the rail. All of these devices are installed immediately ahead of the switch and have as their purpose the deflecting of the car wheels away from the point that is subject to the greatest wear.

All of the types mentioned should be given consideration in a study of the need for protection at any turnout or series of turnout. No one method can be applied with equal effectiveness under all conditions. Guard rails are of doubtful value, except at turnouts leading from the inside of curves. Short guards placed on the outside of the running rail should not be used where locomotives with blind drivers are operated.

The guard-rail type is probably the most expensive of the switch-point protectors to install when both labor and material are considered. It is, however, one of the safest and most satisfactory of these devices. Its installation can be justified only in heavy-traffic tracks where the alinement is such that the guard rail will deflect the car wheels away from the switch points. Before making an installation, a careful study should be made of the cost of switch-point renewals at the turnouts under consideration, based on actual records.

Staggering Switch Points

The question of staggering the switch points should be given serious consideration, as we have obtained excellent results by doing this. We have one guard-rail installation at a No. 9 turnout leading from the inside of a 4-deg. curve, which is laid with 100-lb. rail, the switch points being 15 ft. long. We handle 4,700 facing-point movements, aggregating 200,000 cars, a year through this turnout, and 3,800 trailing-point movements, aggregating 122,000 cars. To date, this point has been in service for 25 months and is still in safe and serviceable condition.

Outside guards are less expensive than ordinary guard rails, since they are made of manganese steel and have excellent wearing qualities. They are easily applied and are economical, all factors considered. The car wheels are guided away from the switch point through contact of the outside of the wheel in the same manner as by a self-guarded frog.

Manganese switch-point protectors that are applied on the gage side of the rail fit against the head and web of the rail, and are held securely in place by means of bolts through the web. The contour of the protector is similar to that of a switch point, and its effect is that of a supplementary point ahead of the switch. This type is reversible, so that double life is obtained from it. It is inexpensive, easily applied and effective in reducing wear on the points. Welded protectors placed on the inside of the rail immediately ahead of the point, serve the same purpose and function in much the same way as the bolted manganese-steel protector. They have a limited service life and should not be used where wear is excessive.

Careful study should be given to the matter of making a switch-point protection installation at any turnout. If this is done, it will be found that this protection is not needed at most turnouts, since at many of them the points will have a life comparable with the lead rails of the turnout.

How One Railroad Checks Safety of Tools

ABOUT three years ago, the Gulf, Mobile & Northern inaugurated a system of tool exchange and inspection among its track and bridge and building gangs which involves the periodic exchange with the system storekeeper of all track mauls, chisels and sledge hammers to insure possession by the workmen only of tools in first class condition. In this plan, new or reconditioned sets of these tools are shipped out by the storekeeper to a few sections at the beginning and middle of each month, following a program whereby all sections receive a complete set of these tools about every ten months.

Immediately upon the receipt of these tools the foreman ships his complete set of replaced tools to the storehouse, where they are subjected to careful inspection. Any defective tools are either repaired or scrapped, depending upon their condition. In addition to this positive exchange of tools, definite instructions have been issued to the effect that if a tool fails or becomes defective in the interval between renewal dates it must be sent to the storekeeper at once and a new one ordered to replace it.

This plan has worked so well that not a single accident caused by the chipping of any of these tools has occurred since it has been in effect, although, before the establishment of this plan for the exchange of these tools, such accidents were rather frequent. When the success of this plan became so apparent early last year, specific instructions were issued by the chief engineer covering its details and the responsibilities and actions of each man concerned as follows:

On March 15, 1938, there will be shipped to each of the foremen on three consecutive sections, a complete set of inspected and first class mauls, track cleavers and sledge hammers.

Immediately upon receipt of these tools foremen must ship all similar tools on hand to the storekeeper at Mobile, Ala. No trading of tools will be allowed. In the event that any tool received is not in first class condition, return the defective tool to the storekeeper and wire me immediately and every day following, until a first class tool is received.

On April 1, 1938, three sets of tools, as above, will be sent to three other foremen, and everything must be handled by these three foremen in the same way. Then on April 15, 1938, three other foremen will be supplied in the same manner, and so on, so that the first and fifteenth of each month certain foremen will receive new or re-conditioned tools.

Inasmuch as we have 56 gangs handling such tools on the railroad, each gang will receive a set of inspected, first class tools in a period of ten months. At the end of that time we start again, in the exact order that the first swap of these tools was made, and so on, until this bulletin is cancelled; and in my opinion it will never be cancelled.

This will mean that every maul, cleaver or sledge hammer in use at any time, any where, will have a thorough inspection by the storekeeper every ten months, and will be shipped out in first class shape, new or reissued.

If any one does not understand the details and the purpose of the above instructions for handling the tools, write me immediately—because a failure to handle in detail and to the letter as outlined above will be considered a serious offense, and I

(Continued on page 246)

Dismantle—

Above—The 900-Ft. Single-Deck End of the Moved Platform—Right—The 400-Ft. Double-Deck End

Reconstruction work carried out by the Belt Railway of Chicago at its large classification yard at Clearing Ill., necessitated the moving of a 900-ft. single-deck and a 400-ft. double-deck icing platform, including 88 timber bents and 176 concrete footings, a distance of more than a mile. This article tells how the work was planned and carried out with a relatively small force in about a month's time, using nearly all of the material in the existing structure

IN connection with the recent rebuilding of the large classification yard of the Belt Railway of Chicago, at Clearing, Ill., where the facilities were rearranged and enlarged and supplemented with car retarders to speed up classification, it was necessary to dismantle, move and re-erect 1300 ft. of single- and double-deck icing platform, and to build 175 ft. of unloading platform, to provide new car icing facilities at a location that would be most effective under the new plan of yard operation. The platform work, which involved the moving of 176 concrete footings, 88 single- and double-deck platform bents, and many thousand feet of plank decking and bracing, as well as the ice conveying equipment, was carried out in accordance with a carefully prepared plan of procedure, so that, employing only a small force, the platform was re-erected in its new location in a relatively short period of time, and in as good condition as before.

The original icing facilities at Clearing lay immediately south of the eastbound classification yard, and included an ice manufacturing plant of the Railways Ice Company, and two sections of single-deck platform, 500 ft. and 900 ft. long, respectively, separated by a double-deck section 400 ft. long. The deck of the single-deck sections and the lower deck of the double-deck section were continuous at the same level, at approximate car-roof height, 14 ft. 6 in. above top of rail, while the upper deck of the double-deck section, used for the distribution of crushed ice via chutes to car bunkers, was at an elevation of 23 ft. above the top of rail. Both decks were 17 ft. wide and provided for icing from both sides. The 500-ft. section of single deck and 400-ft. section of double-deck platform, forming the east half of the platform as a whole, were built in 1922 and 1923, while the 900-ft. section of single-deck platform forming the west half, was built in 1931.

Complete Icing Facilities

As operated in its original location, cake ice, delivered directly from the ice plant, was conveyed throughout the entire length of the combined platform by means of motor-operated chain-type conveyors, so that the ice, in cake form, could be delivered to cars anywhere along the platform. In addition, the facilities included an ice crusher, and a chain-bucket-type conveyor which elevated the crushed ice to the high deck level, where it was distributed to the bunkers of cars in the usual type of two-wheel ice buggies. Another facility afforded was a salt storage house, with a chain-bucket-type conveyor leading to a salt chute at the high deck level. From this point, the salt was discharged into salt buggies, by means of which it was distributed to the points of icing.

Split Existing Facilities

The new operating conditions planned at Clearing dictated the desirability of moving at least the major portion of the icing facilities to a point between two of the four eastbound receiving or hump approach tracks, immediately adjacent to the south side of the westbound classification yard, a move of approximately 5,600 ft. This new location, provided with two continuous icing tracks, was to make possible the re-icing of entire trains of cars received from the West, before they were humped into the eastbound classification yard for forwarding to the large number of roads served by that yard. It was desirable to continue limited icing facilities at the original location, even under the revised system of operation, to permit the re-icing of miscellaneous cars brought in and humped with general merchandise freight trains, so in the plan evolved, only 1300 ft. of the existing platforms, including the 400-ft. double-deck section and the 900-ft. single-deck section, were moved. This left the icing plant itself and 500 ft. of single-deck platform in their original locations for the miscellaneous icing that was

Move—Re-Erect Long Icing Platform

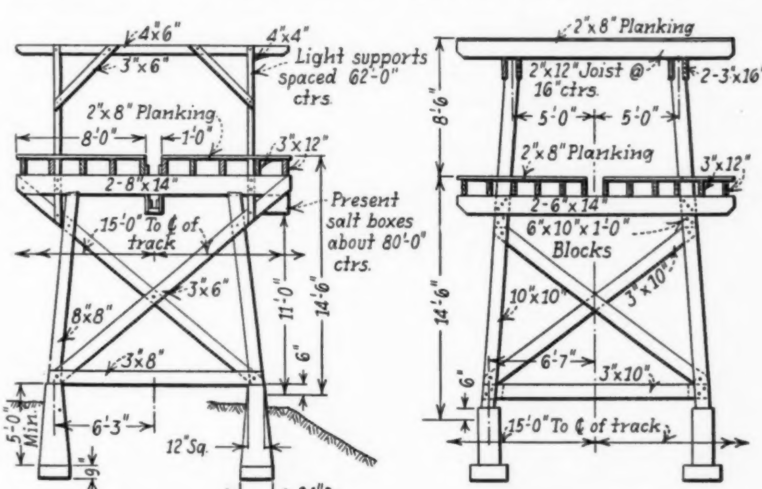
still to be done at the east end of the yard. In connection with the moving of the remainder of the platform, a 175-ft. length of car-floor-level ice unloading platform was built at the new location to meet the need for ice delivery by car from the original plant.

Turned Around in Move

One of the interesting phases of the platform moving work was the fact that the new method of operation required that both the single- and double-deck sections moved be turned around, end for end, putting the single-deck section at the east end, followed by the 400-ft. double-deck section to the west, and then the 175 ft. of new unloading platform. From the unloading platform, which is served throughout its length by a chain conveyor, the ice is moved up an incline to the continuous car-roof-height deck of the two main sections of the platform, which, as under the old arrangement, is served throughout its length by a chain conveyor. Directly at the top of the incline from the unloading platform in the new layout is located the ice-crushing equipment, and a conveyor which takes it to the upper deck of the double-deck section. At the opposite end of the double-deck section, as in the original layout, is the salt elevating equipment, which is fed from a salt storage bin beneath the lower deck level.

The 900-ft. section of single-deck platform moved was made up of 59 panels, each 15 ft. 6 in. long, and involved 60 timber post bents, which were tied together longitudinally in each fifth panel by cross-bracing. In this section of platform, the bents consisted of two 8-in. by 8-in. batter posts, with 3-in. by 6-in. cross-bracing, two 8-in. by 14-in. cap pieces, and a 3-in. by 8-in. horizontal strut across the bottom. The deck structure above the caps was made up of 3-in. by 12-in. joists on 22-in. centers, which supported 2-in. by 8-in. planking, continuous across the top, except for a channel longitudinally through the center, 12 in. wide, which housed the ice conveyor.

The double-deck section of platform was of much the same construction as the single-deck section, except for the increased size of certain members. Each bent in this section involved two 10-in. by 10-in. batter posts, continuous to the upper deck level, 3-in. by 10-in. bracing below the lower deck level, two 6-in. by 14-in. cap pieces at the first deck level, and a 3-in. by 10-in. strut across the base. The first deck was of exactly the same construction as that in the single-deck section, while the second deck, subject to lighter loads, consisted of 2-in. by 12-in. joists on 16-in. centers parallel with the bents, which were supported on two lines of 3-in. by 16-in. stringers connecting the tops of adjacent bents. The flooring on the top deck, like that of the lower deck, consisted of 2-in. by 8-in. plank, but at the higher level was continuous across the full width of the deck of the platform.



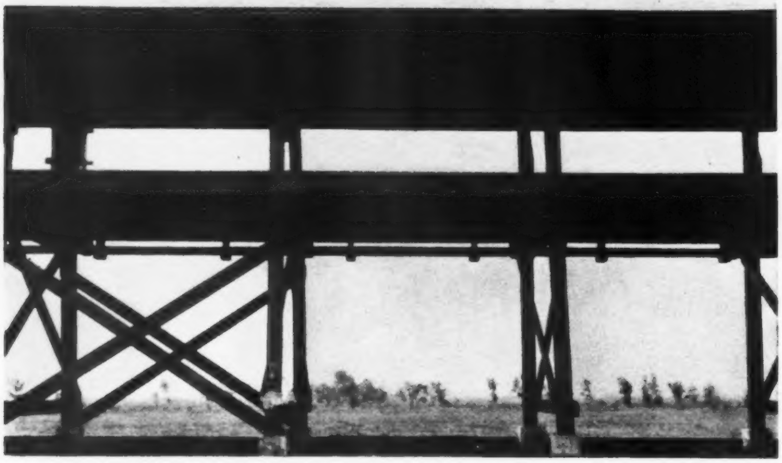
Typical Cross Sections of the Single-Deck and Double-Deck Icing Platforms Moved at Clearing Yard

Bents Moved Intact

The moving of the platform was essentially a dismantling and re-erecting project, simplified considerably by the shortness of the move, but complicated somewhat by the fact that the platform had to be turned end for end, and by the interferences of work on adjacent tracks. A further complication was the fact that uneven ground at the new location of the platform required that the level of each bent footing be set accurately by instrument.

The work was carried out by a force which varied in size from 40 to 60 men, divided in two groups, as necessary, one group being engaged in the dismantling work, while the other handled the re-erecting work. In carrying out the work, the individual bents were handled as units, and were loaded into and moved in gondola cars after they had been carefully marked in numerical order to insure that they would be re-erected in the same relative position in the rebuilt platform. At the same time, each concrete pedestal was numbered and designated north or south, (N), (S), and all other material, such as joists, deck plank, bracing, etc., was loaded together, for a panel or two at a time, so that it, likewise, could be re-used in its same relative position.

All of the handling of the bents and



Close-Up View of a Section of the Double-Deck Platform, Note Position Identification Markings Placed on Posts, Stringers and Footings

pedestals in both the dismantling and re-erecting work was done with locomotive cranes. In removing the pedestals, which ranged in height from approximately 4 to 6 ft., with from 3½ to 5 ft. below the ground level they were hand excavated on three sides as much as necessary, and were then pulled out by a crane. More than ordinary hand excavation was required in the case of many of the pedestals because the ground was frozen at the time the work was carried out.

All excavation for the resetting of the pedestals in their new locations was done by hand in accordance with carefully staked out locations and levels. This work was simplified by being largely in sand. To insure compact foundations for the pedestals, the excavation for each was left an inch or two high, and the pedestal was dropped a foot or more by the crane in setting it. On occasions, the pedestals were raised and dropped several times until they were at the exact level desired and accurately located in plan. With this accomplished, no work other than back-filling was necessary before the bents could be properly set in place.

134,320 F.B.M. Moved

Following the procedure outlined, the sections of the existing platform were dismantled progressively and, concurrently, were re-erected progressively in their new locations, the force of men employed at each location being adjusted in size, as necessary, to keep the two stages of the work properly co-ordinated. To a large extent, the old spikes, bolts and other hardware of the original structures were renewed to insure minimum maintenance work on the rebuilt structure, and, for the same reason, any decayed or worn-out decking or other pieces of timber were renewed. These latter renewals were, however, relatively small, the lumber used in replacements amounting to only 34,750 f.b.m., equivalent to less than 26 per cent of the total material contained in the entire platform.

New Unloading Platform

With the completion of the re-erecting work proper, the ice-conveying machinery was re-installed; the new 175-ft. ice-unloading platform was built at the west end, with a conveyor ramp to the car-roof-level deck of the icing platform proper; a new frame salt house, 31 ft. by 13 ft., was built at one end of the double-deck section, at the salt handling station; and a combined-purpose, office, locker, tool and shelter building, 25 ft. by 22 ft., of frame construction, was built beneath the ramp connecting the unloading platform and the double-deck platform.

The new unloading platform, 7 ft. 8 in. wide, was built entirely of new material, including 6-in. by 8-in. posts. alternate 4-in. by 10-in. and 3-in. by 10-in. joists, and 2-in. by 8-in. decking. The posts, hip-braced along one face of the platform and cross-braced in each fifth panel, rest on poured-in-place cylindrical concrete footings, 8 in. in diameter, each capped with a poured-in-place 12-in. by 12-in. concrete block, 12 in. deep.

The holes for the footings were dug with a post hole digger to an average depth of 4 ft., and the concrete was poured directly in the holes, without formwork. A ⅝-in. steel dowel was provided in the top of each footing to anchor the cap, and when the cap was poured, a steel strap, 2 in. by ¼ in., and 14 in. long, was set vertically in place, projecting 6 in. above the top, to provide a means for anchoring the timber post above.

The entire work of moving the icing platform and of building the unloading section was carried out in a little more than a month, which included delays of several days at a time occasioned by bad weather and adjacent grading and track changes. No special difficulties of any kind were encountered, and with the change the road now has a practically new facility, properly located and well equipped to meet its revised operating conditions.

The work of moving the platform was carried out under the general direction of F. E. Morrow, chief engineer of the Belt railway, and V. R. Walling, engineer maintenance of way, and under the immediate direction and supervision of A. B. Hillman, assistant engineer, and H. C. Koch, track supervisor.

Checks Safety of Tools

(Continued from page 243)

will clamp down on any offender. Please remember that this is for your benefit as well as the railroad's.

In case a tool turns bad at any time within the ten months period, ship it to the storekeeper at Mobile, Ala., and order one to replace it. Then wire every day until you get a first class replacement.

Play safe and don't let any one give you a poor tool. Keep on shipping the poor ones in, even if it means shipping tools every day in the year, for every one knows that we have always insisted that our men must not use bad tools.

The two essential features of this plan which make for safety are, first, that defective tools must be sent in immediately, and secondly, that a regular system of thorough inspection is maintained. The G.M.&N. has found that an unsafe tool which is kept on hand to be turned in later is a potential hazard and that the plan of periodical inspection by the storekeeper of tools sent in constitutes an additional check against the inspections which may be made from time to time by the foremen. The proof that this plan has merit is in the record made by the G.M.&N., both in the elimination of all personal injuries due to flying chips of steel from these tools since the plan has been in effect, and in the fact that this road was the winner in its group in the annual railroad employees' national safety contest for the year 1937.

Effect of Size of Ties

How does the size of ties, with respect to their width, depth, length and uniformity of dimensions affect track maintenance?

Uniformity Beneficial

By C. S. Kirkpatrick
Chief Engineer, Gulf Coast Lines and International Great Northern, Houston, Tex.

Ties should be wide enough to permit uniform tamping from edge to edge, considering the kind and size of the ballast. They should extend and be tamped an equal distance each way from the rail, and be long enough so that the untamped space at the center will be the minimum. They should also be of uniform thickness to insure that they will lie in the same plane in the roadbed. In other words it is injurious to the riding condition of the track and increases maintenance costs to have thick ties adjacent to thin ones.

The tamped ballast has no bearing value for a distance of from 3 to 6 in. from the end of the tie. Building up the shoulder of the roadbed with great care to a uniform height, thus giving good support to the ballast shoulder, is one of the most helpful things that can be done to produce good riding track. A high ballast shoulder, regardless of the cross section or length of the tie, permits center-bound track. By providing a well built-up uniform embankment shoulder, which should not be more than 6 in. below the bottom of the tie, greater stability is obtained.

Ties that are long enough to give proper and equal support to each rail, that is, not less than 8 ft. 6 in., and are of uniform width and thickness, will give a uniform bearing, will improve riding conditions and will reduce maintenance expenses. Increases in speed and in axle loads are making it more important than heretofore to have longer ties of uniform thickness. Maintenance engineers know from experience that uniform width and thickness in ties, with proper length, produce economies, although it is difficult to state definitely what the saving is. All that is known is that the track rides better and is more easily and economically maintained.

Dimensions Are Inherited

By C. D. Turley
Chief Tie Inspector, Illinois Central, Chicago

The width, depth and length of crossties have been handed down from the early days of the railroads, apparently with more regard for precedent and commercial timber standards than for suitability as members of a well-designed structure designed to perform certain functions satisfactorily. More severe and more exacting demands are being made on track by reason of heavier wheel loads and higher operating speeds during recent years, and these have tended to focus attention on the track structure and particularly on ties.

The purpose of the crosstie is to hold the rail to gage; to distribute the concentrated wheel loads to the ballast and roadbed; to support the rails in position both vertically and horizontally, thus providing good line and surface; and to provide the ballast contact that is necessary to prevent the creeping of the rail. In general, crossties for standard-gage track are either 6-in. by 8-in. by 8 ft. or 7-in. by 9-in. by 8 ft. 6-in., and this discussion will be confined to these sizes.

Send your answers to any of the questions to the What's the Answer editor. He will welcome also any questions you wish to have discussed.

To Be Answered in June

1. *Should tie renewals be started at a fixed time? If not, why? If so, when and how is this determined? Should the date of completion be fixed? Why?*
2. *How frequently should steel sash in enginehouses and shops be painted? Wood sash? Why? What details should be given special attention?*
3. *Should the track be surfaced when new rail is laid? Why? If so, how closely should the surfacing gang follow the rail gang?*
4. *Under what conditions are test wells necessary or advisable in the development of underground water supplies? Why? Should they be of the same size as the permanent wells? If not, how can the capacity of the latter be estimated?*
5. *What are the relative advantages of tamping ties with shovels, with tamping bars or tamping picks and with tie tampers? The disadvantages? Does the kind of ballast make any difference?*
6. *Where a timber trestle is replaced with a concrete culvert, what period should elapse after the culvert is installed before the filling is started? What precautions should be employed in placing the fill?*
7. *What effect does the spraying of the roadbed with oil to keep down dust have on the ballast? Is this effect permanent? Is the practice desirable from the maintenance standpoint? Why?*
8. *What advantages are there in the use of power-driven saws in bridge and building work? For what purposes are they best adapted?*

Obviously, the larger ties are desirable on heavy-traffic, high-speed lines, but the question is sometimes raised whether the decrease in maintenance resulting from the use of larger ties is sufficient to offset their higher cost and the increased interest charges.

A tie should be of such length that the bearing area on each side of the rail is equal. The reduced bearing of the ballast near the end of the tie and the untamped portion at the center of the track are determining factors. Increased bearing is desirable and an 8-ft. 6-in. tie has approximately 17 per cent more bearing than one 8 ft. long. The bearing area is also increased almost in direct ratio to the width of the tie, so that one 9 in. wide has approximately 12½ per cent more bearing power than one 8 in. wide.

Since the tie acts in some respects as a beam, it should be designed to keep the deflection at the rail base to the minimum as the wheels pass along the rail. The stiffness of a beam varies as the cube of its depth, and actual experience in the field seems to justify the use of ties 7-in. instead of 6-in. deep. Again, ballast resistance to the movement of the tie under the stresses imposed by rail creepage is increased materially by the deeper tie. Ties should be uniform in length and width or they cannot provide uniform support for the track; the depth should also be uniform, for the cost of tie renewals is materially greater where ties of varying thickness are in use.

Increased support will be given to the track and increased resistance to rail creepage will be obtained if the length, width and thickness of the ties are increased. Studies indicate that where 7-in. by 9-in. by 8-ft. 6-in. ties are used, the value of the track support is increased approximately 31 per cent, and the available resistance to rail creepage is from 15 to 20 per cent greater, compared with 6-in. by 8-in. by 8-ft. ties. Against this, the total cost of the ties in track will be about 20 per cent greater. On the other hand, while the data are largely intangible, it is concluded that where the density of traffic is high the reduction in maintenance costs by reason of improved track support, will be greater than the higher cost of the larger tie.

Needs Careful Study

By H. E. Herrington

Section Foreman, Minneapolis & St. Louis, Jordan, Minn.

Since the crosstie is of equal importance with the rail in supporting wheel loads and distributing them to the ballast, their dimensions should be given careful study to insure that they are of the proper size to meet the requirements where they are to be used, and that at the same time they demonstrate the greatest over-all economy. Because they must perform the dual purpose of supporting the rail and holding it to gage, the stability and safety of the track depend in large part on how they meet these requirements, and this is determined to a considerable extent by their dimensions.

Obviously, a tie that is suitable for a main track in high-speed, dense traffic lines may be too expensive for an unimportant branch, while one that is entirely suitable for the branch line may be uneconomical for the heavier traffic line, although its original cost may be much less. While the standard specifications permit three lengths and seven cross sectional areas, in general two sizes are in common use for main tracks, namely 6-in. by 8-in. by 8 ft., and 7-in. by 9-in. by 8-ft. 6-in. These specifications also limit the variations from standard dimensions so that ties are now far more uniform in size than formerly.

Assuming that the basic dimensions are correct for the traffic requirements, one of the most important assets a lot of ties can possess is uniformity in size. Lack of uniformity creates unequal support for the rail, making it difficult to keep the track in good riding condition. It causes abuse of the rail under almost any volume of traffic, and it increases maintenance costs. These statements apply to thickness or depth in the same measure as to length and width, and with equal force in any kind of ballast.

Advantages of Compressed Air

In what ways can compressed air be used to advantage in bridge and building work?

In Many Ways

By H. Austill

Chief Engineer, Mobile & Ohio, St. Louis, Mo.

Compressed air can be used to advantage in so many ways in bridge and building work that its use is now almost indispensable. While expensive, the sand blast for cleaning surfaces that are to be painted is the most effective method that I have found for this purpose. Metal that has become rusty and has developed scale is almost always pitted and numerous pits will be found. It is most difficult to remove the scale from these small pitted cones by the ordinary methods of cleaning, but the sand blast will do this thoroughly, leaving a clean metal surface to the bottom of the pits.

In the painting of both bridges and buildings, the paint spray is now being used so widely that it is practically a general practice, and I recommend it highly on the basis of quality, quantity and cost of painting. Both sand blasting and spray painting are dependent on the use of compressed air, for which reason they would not be possible if it were not available.

Another wide use of compressed air is in the driving of rivets. This application is so general that one expects to hear a riveting hammer at work whenever he is around a structural erection job. Compressed air is equally useful for the operation of rivet busters, chippers, drills, reamers, air hoists, grinders, rotary brushes and other small power tools that are adapted for bridge and building work, including wood-boring machines, saws and pneumatic wrenches. The pneumatic hammer is an ideal tool for driving sheet piling.

A heavy air hammer with the proper incidental tools is an excellent machine for excavating in soft rock, while the jackhammer type of tool is best for drilling into masonry for setting dowels or anchor bolts, or for preparing holes for blasting old masonry. One of the most recent applications of compressed air is for the operation of vibrators for vibrating concrete, a most effective method for compacting concrete as it is deposited. In fact, once a bridge or a building gang has been provided with an air compressor and a complement of portable pneumatic tools, they at once become indispensable, and the uses to which they can be put become more numerous and the effectiveness of their use grows with experience.

Has Many Uses

By L. G. Byrd

Supervisor of Bridges and Buildings, Missouri Pacific, Poplar Bluff, Mo.

There is a decided advantage in the use of compressed air as an aid in the performance of many classes of bridge and building work, not the least of which are the greater accuracy and higher economy which result from the use of portable tools. Our experience

in the use of compressed air for the operation of small power tools extends over many years in the construction and maintenance of timber as well as steel bridges, and more recently, as tools adapted for the purpose have become available, this use has been extended to building work.

Some years ago a comparison was made between the cost of boring holes in a long pile bent trestle by hand and by wood borers operated by compressed air. The reduction in labor cost by the latter method ranged from 40 to 60 per cent, depending on the conditions surrounding the various sections of the structure. In fact, the saving was of such magnitude that the complete outfit was more than paid for by the reduction in labor cost on this job alone. In addition, the same outfit has been used similarly many times since, and with additional tools it has been employed to drill anchor holes in concrete piers, for operating paving breakers, riveting hammers and rivet busters, in each case demonstrating equal or greater savings. An item to be taken into account in this connection is that experience has shown that in these applications this equipment reduces the safety hazard by as much as 80 to 90 per cent, compared with hand work.

Compressed air outfits, particularly the compressor units, are generally recognized as being heavy and somewhat unwieldy to handle, especially where it is necessary to remove them from the track. This has been one of the chief objections to their use in bridge and building work, and in not a few cases is a legitimate one. Obviously, however, the size or needed capacity of the equipment has much to do with the difficulty of handling it. Where sand-blasting is employed it is necessary to use compressors of large capacity and heavy weight to insure dependability, safety and economy in the performance of the work. On the other hand, where a large steel bridge must be cleaned thoroughly, the large compressor outfits in common use on the railway can be handled and maintained more economically than any other class of equipment with which I have had experience.

These large outfits are not necessary for many of the applications of compressed air, spray painting being an example. Light-weight compressors of lower capacity are available for spray painting, and their use will demonstrate a saving of from 40 to 70 per cent of the cost of hand painting, depending on the class of painting involved and the conditions under which it must be done, while from 10 to 30 per cent of the material cost can be saved, although this latter saving is not always made.

Light-weight outfits can also be used to advantage for the operation of grinding machines for cleaning small steel structures, for surfacing and resurfacing concrete, for the operation of cut-off and rip saws, for the operation of small drills, particularly in replacing broken cap stones in small culverts, a type of work that cannot be done to advantage by hand. Compressed air is also being used widely for many types of work which cannot be classed strictly as bridge work, but which is related to it, as for instance, in connection with air hoists in timber and structural material yards, permitting the material to be handled, loaded and unloaded at very low cost.

Air Pockets in Pipe Lines

What is the cause of air pockets in pipe lines? The effect? The remedy?

Reduce Effective Area

By C. R. Knowles
Superintendent Water Service, Illinois Central, Chicago

Air pockets in pipe lines result from the accumulation of entrained air at peaks or summits in the lines. Obviously these accumulations are subjected to the same pressure as the water in the line and are compressed in such a way that the effective area of the pipe is reduced, resulting in a decreased delivery of water or necessitating an increased pressure if the same volume of water is to be delivered. These air pockets are most likely to occur at sharp summits and with low velocities and pressures. There are records of the delivery of water from centrifugal pumps having been decreased as much as 60 per cent by reason of air pockets in the discharge line.

Air pockets can be prevented by laying the pipe line to a uniform gradient, thus eliminating peaks or summits, which are the points of accumulation for the air entrained in the water. Obviously, this is not always practicable, for pipe lines must generally follow somewhat closely the contour of the ground surface and to provide a uniform gradient for a long pipe line in rolling country may be physically impossible or if possible may involve excessive cost. For this reason, it becomes necessary to provide means for draining off the air that accumulates at these high points to insure that the entire cross-sectional area of the pipe will be effective. While the escape of the air can be regulated by hand-operated valves, it is preferable for several reasons to install valves that will bleed the air off automatically.

Several types of automatic air-bleeding valves are available. A type in common use consists of a float chamber, and a float that is attached to a lever which opens and closes the valve. As air accumulates in the pipe line it finds its way into the float chamber which is placed above the pipe at its highest point. When the air enters this chamber, it displaces an equal volume of water, causing the float to drop and depress the lever, thus opening the air valve. As the air escapes the water returns to the float chamber, the float is raised and the lever is lifted, automatically closing the valve.

Another type consists of a straight cylinder or float chamber with an opening in the top to permit the escape of the air. A hollow brass ball enclosed in a basket is suspended from the top of the float chamber, and as the air collects in the cylinder the ball drops into the basket, uncovering the air vent. As the air escapes the water enters, floating the ball against the seat, thus closing the outlet.

With both types, the operation of opening and closing the passageway for the escape of the air is repeated as often as the air accumulates, and is entirely automatic. It will be seen too that while the air is bled off as it collects in the float chamber, enough residual air is retained so that water is not allowed to escape. Air valves are commonly provided with openings ranging from 5/16 to 1 in. in diameter, the size of the pipe, the operating pressure and the rate of delivery determining the size of the opening to be used.

Collects at High Points

By E. M. Grime
Engineer of Water Service, Northern Pacific, St. Paul, Minn.

Air pockets result from entrained gases which enter the pipe line with the water as it is pumped. These gases are usually nitrogen and oxygen, in the form of air, and carbon dioxide. The amount drawn in will depend on the saturation point of the water

when exposed to the atmosphere at a given temperature and upon the condition of the pump which may suck in varying amounts of air, depending on the degree of tightness of the packing glands.

There is a tendency for the air to collect at the high points in the line, particularly if these points come above the hydraulic gradient. The capacity of the line is reduced at such points by the volume taken up by the gas pocket just about as effectively as if the pipe itself were reduced in section at that point. When pump suction lines contain air pockets, the efficiency of the pump is reduced correspondingly, for which reason it is important to have the upper surface of the interior of the pipe line rise steadily from the intake to the connection with the pump.

To avoid this trouble, careful attention should be given to having the profile of the pipe line conform as nearly as practicable to a uniform gradient. If one or more points must come above the hydraulic gradient and cannot be lowered at reasonable expense because of the contour of the ground, automatic air-relief valves should be installed at these summits. While this does not create an ideal condition, these valves will remove most of the collected gases and relieve the constriction which they create.

Lateral Stiffness of Track

What are the most effective means for increasing the lateral stiffness of the track, independent of the weight of rail?

Correct Faults At Once

By W. E. Folks
Track Supervisor, Cleveland, Cincinnati, Chicago & St. Louis, Cincinnati, Ohio

All faults of line, surface, level, gage, joints and spiking should be corrected as soon as they are in evidence, and all loose ties should be tamped. Attention to these details and a full ballast section will do more to keep the track rigid and resistant to both vertical and lateral forces than any other factor. These items are so completely interdependent that if any one of them is neglected it will soon cause defects in the others. Uneven gage causes side thrusts that soon work the track out of line; then the surface and cross level are affected, and the trouble spreads until the track seems to lose its lateral stiffness. Loose joints and poor spiking allow the rail to have play both vertically and horizontally and much of the lateral stiffness is gone when this condition exists.

Double-shoulder tie plates add considerably to lateral stiffness, compared with those having only one shoulder. Experience has shown also that track having an adequate number of anticreepers to the panel is stiffer than unanchored track. For maximum effectiveness of all of these factors, the ties should be sound and spaced evenly.

Obviously, heavy rail, because of its inherent stiffness, adds to the lateral stiffness of the track, but this does not eliminate the necessity for keeping after the items of track work that have been mentioned or permit any neglect of the principles of good maintenance, contrary to the belief that has sometimes been expressed. Good construction in the beginning and careful maintenance thereafter will add to the lateral stiffness of the track, regardless of the weight of the rail. A full section of clean ballast will reinforce the lateral stiffness of the track, but does not of itself increase this stiffness.

Several Designs

By H. R. Clarke
Engineer Maintenance of Way, Chicago, Burlington & Quincy, Chicago

Probably the most effective means for increasing the lateral stiffness of track, independent of the weight of rail, is to build a more rigid track structure than is generally considered standard. By this is meant some type of special construction which is designed to hold the rail rigidly against lateral movement, and against relative movement with the tie plate and tie. There are several such types available, all based more or less on the theory of holding the rail, tie and tie plate firmly together by means of clips or spring devices of various kinds.

In some of these, screw spikes are used to fasten the plate to the tie; in others cut spikes are employed, and there is a marked diffierence in the degree of rigidity in the various types of structure thus produced. The more firm and rigid the track structure, the greater the increase in lateral stiffness.

While the kind of ballast will not change the lateral stiffness of the track structure, it does have a decided influence on holding the track in line and thus reinforcing the inherent stiffness of the structure. That is, a heavy ballast in which the ties become embedded firmly offers greater resistance to lateral movement of the track than a lighter ballast does, in which the track ties shift more easily.

Several Factors Involved

By W. L. Roller
Division Engineer, Chesapeake & Ohio, Columbus, Ohio

Aside from the weight of the rail, the lateral stiffness of track depends on several factors, the more important of which are the type of tie plates, the method of fastening the plates to the ties, the tightness of the bolts in the joints, the condition of the ballast in the cribs, the condition of the cross level and the accuracy of the gage. One of the most effective means for insuring stiffness and comparative rigidity of the track structure is to employ double-shoulder tie plates, seating them evenly and anchoring them securely to the ties. They should be shouldered neatly against the base of the rail before spiking and lagging, to secure perfect alinement of the rails.

Joint bars should fit snugly against the fishing surfaces of the rail, and all bolts should have a uniform or approximately uniform tension. In tightening, the joint bars should be tapped with a hammer to insure a snug fit, and thus permit further tightening of the bolts without exceeding the allowable tension. After new rail has been under traffic for a short time the bolts should be retightened once or twice to take up the slack created by the wearing off of the mill scale from the surfaces of both the rail and the bars.

An important contribution to the stiffness of the track is clean, hard, broken-stone ballast having sufficient angularity, under and surrounding the ties. The resistance to movement of the ties offered by such ballast insures the maintenance of good alinement and surface. In other words, well-ballasted track is less likely to be displaced laterally by the holding power of the ballast around as well as under the ties.

Other conditions commonly found which, in themselves, do not increase or diminish the stiffness of the track, yet which may cause the track to be subjected to unusual strains and stresses, and in turn may result in lateral displacement of the sturdiest track, include unequal cross level, lack of uniform gage and poor surface. Track that is out of level causes unequal loading of the rails and swaying

or lurching movements of the equipment, thus subjecting the track structure to unwarranted vertical and lateral strains. Uniform gage is a guarantee against lateral displacement of the track because it minimizes the effect of nosing action by the trucks of moving equipment. Consequently, when the desired stiffness of the track has been attained, it is vital to maintain it in good cross level and gage, if lateral displacement is to be avoided.

Extenders in Paint

What is an extender in paint? What is its purpose? What are the advantages and disadvantages?

Extenders Are Bulky

By Master Painter

Extenders are bulky pigments which are added to the regular pigments to cheapen them. They perform no useful function; in fact, they are definitely detrimental. Ordinary pigments are opaque, so that they produce a film into which the ultraviolet rays of sunlight cannot penetrate. On the other hand, most of the extenders in use have the same refractive index as that of linseed oil, so that they become transparent when mixed with it. As a consequence the hiding power of the paint is reduced and the film is subjected to the destructive effect of light, a factor of no small importance in its influence on the life of the paint.

Furthermore, since, weight for weight, extenders have from two to three times the bulk of the regular pigment, they decrease the spreading power of the paint, as well as reduce its resistance to weathering. Since the function of the pigment is to protect the vehicle and since extenders do not do this but on the contrary add to the destructive forces that act on the paint, it is evident that their use is detrimental in all respects.

To Increase Bulk

By General Inspector of Buildings

An extender, as the term applies to paints, is an adulterant added to the pigment to increase its bulk, the primary purpose being to cheapen its cost. While they do this, they also impair the quality of the paint with respect to protective value and resistance to the elements. If they are used with a rust-inhibiting pigment they seem to hamper the functioning of the normal pigment and to permit the process of corrosion to proceed, in some cases accelerating the action the pigment was intended to prevent.

It may not be generally understood that the vehicle of paint offers scarcely any resistance to the forces which act upon the paint to destroy it. This resistance is afforded almost wholly by the pigment, the vehicle being only what its name indicates, a medium for holding the pigment in place. This function is performed in two ways, first by the suspension of the minute particles of the pigment in the liquid vehicle and, in the case of the lead paints, by the formation of lead soaps through chemical reaction with linseed oil. This chemical combination adds much to the strength and imperviousness of the paint film.

Extenders are inert to linseed oil, and since there is no mutual attraction the film is weakened, this material acting only as a filler. Furthermore, extenders tend not only to floc but to cause the ordinary pigment to do so too, leaving relatively large areas of the surface without the protection the pigment was intended to afford. Taken all in all, extenders reduce the quality and shorten the life of paint.

How Many Emergency Rails?

Are emergency rails on each section necessary? If so, how many? Where should they be located? Should they be retained unused until needed? Why?

A Subject of Long Debate

By W. H. Sparks
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

This is a question that has long been debated and never settled. Emergency rails should be defined as rails held for the replacement of broken or otherwise damaged rails, not for the replacement of worn rails. Rail wear invariably progresses at a rate which permits the time for renewal to be foreseen and thus enables maintenance officers to arrange for the needed materials and forces well in advance of the time when replacement becomes necessary. In contrast, rails break or become damaged beyond the possibility of use without previous warning and must be replaced in the shortest possible time to avoid interference with train movements.

Important traffic lines are generally laid with rail heavier than 100 lb., and experience has shown that, in general, the heavier rail is less subject to breakage and other damage than the lighter sections. This greater relative immunity has been aided in recent years by the operation of the detector car to discover hidden flaws. For these reasons, the number of emergency replacements has been greatly reduced compared with a decade or more ago, despite heavier wheel loads and higher speeds.

Another situation exists on branch lines, in that many miles of relatively light sections are found on these secondary lines, even where the traffic, measured in gross tones, is greater than on many main lines, although train speeds may be lower. In general, those lines are laid with second-hand rail and the situation with respect to emergency replacements may be similar to that on main lines 15 to 20 years ago. The rail on less important branches may be still lighter and of obsolete section. Here, because of less trains and generally lower speeds, the number of emergency replacements may be small but, as a measure of safety if for no other reason, all broken rails must be replaced immediately after they are found.

These facts determine my viewpoint on the policy that should be followed with respect to emergency rails. Every main-line section should have from two to four rails on hand for emergency use, the number depending on the weight of the rail in the track, the history of the rail with respect to breakage and the number of track miles on the section. They should be kept at the section headquarters on specially designed rail rests, from which they can be loaded on a trailer in minimum time. They should be changed with rails from the track every so often, say from six months to a year, depending on the volume of traffic, to insure that they will be worn approximately the same as those in the track.

On branch lines the number of rails to a section will depend on the

condition of the rail in the track, the volume of traffic and the speeds of operation. I have known of cases where no more rails were needed than on a main-line section, and of others where 10 to 12 rails were not too many. In the later case it might be advisable to erect rail rests at the mile posts because the sections are likely to be much longer than on main lines. Again, if the rail section is obsolete, the emergency rails should be obtained by laying a stretch of track at some point with a heavier section to release enough of the obsolete rail for emergency use.

They Are Necessary

By L. A. Rape
Section Foreman, Baltimore & Ohio, Claysville, Pa.

I consider emergency rails a necessity, for if they are not readily available a broken or otherwise damaged rail may cause serious interruption to traffic. Under present-day demands for dependability of train movement and for speed, any delay in getting a rail to replace one that is not safe may affect the schedule of several trains. In my experience it has seemed that every time I have had a broken rail one or two important trains were due before I could get it replaced. For this reason, I have come to believe that an emergency rail should be located at every mile post to minimize the time to get the replacement rail to the point of use. There should also be a reserve of two emergency rails at the tool house to avoid delay in replacing the rail or rails that have been used. These can also be used when the call comes at night, for the gang must assemble at the tool house to get the necessary tools and go out on the motor car.

If the rail is new and the detector car is run over the track regularly, one emergency rail to the mile is sufficient. If the rail is old or has not been well maintained, or if the detector car is not operated over the track I would increase the number at each mile post, depending on the number of broken rails that have been found.

If the rails were kept without being used until an emergency requires their use, and this did not occur for five or six years in the case of a particular rail, it is obvious that it would not be satisfactory when placed next to rails that had been in continuous service for this length of time. For this reason, they should be laid in the track from time to time to replace partly worn rails, which should then become the emergency rails. Rail rests in the vicinity of curves should be supplied with rails that are curve worn to approximately the same extent as those in the track. They will then be available for use in the curve or on tangent, as the unworn side can be used as the gage side when replacing rails on tangents.

Must Be Easily Accessible

By J. W. Hinton
Section Foreman, Southern, Livingston, Ala.

If long delays to trains are to be avoided, emergency rails should be kept on every section, preferably at section headquarters. As the sections increase in length, however, it may be desirable to place one or more of these rails at intermediate points to reduce the time required to get them to the point of use. Whatever the location chosen, they should be so placed that they are easily accessible for loading on a trailer quickly and safely with a small force, for the average section gang today is small. Two or at most three rails should be enough for the average section.

When a section is laid with new rail, new rails should be left for emergency use. As wear becomes apparent on the rails in the track, the emergency rails should be exchanged for an equivalent number of partly worn rails, and this exchange should be repeated periodically to insure that when an emergency arises and a rail must be replaced, the rails in reserve will have approximately the same wear as those on either side after they are in the track.

Failures in Built-Up Roofing

What are the causes for failures in built-up roofing? What can be done to prevent them?

Flashing Gives Trouble

By General Inspector of Buildings

If I were asked to name the most frequent cause of failure in built-up roofing, I would say that it is improperly-designed or poorly-applied flashing. I have seen more than one job of built-up roofing in which the workmanship was all that could be asked for, so far as the body of the roof was concerned; yet the job was spoiled by an inferior design of flashing or by inferior workmanship in its application. In fact, I recall one case in which the leakage resulting from a poorly designed flashing caused damage amounting to several thousand dollars in a building that had been in service only a few months.

Another cause that can be traced to poor workmanship is failure to mop each layer of felt sufficiently or to lap the sheets properly. Still another, generally the result of carelessness, is holes in the roofing membrane. Workmen should be required to wear rubbers or rubber soled shoes, and the use of tools or heavy objects having sharp edges should be forbidden.

Built-up roofing is usually applied to roofs of large area and slight pitch, making it particularly important that the roof as a whole or that each segment of the surface lie in a plane. Sags become collecting places for water that will not drain away. During freezing and thawing weather the stagnant water freezes and cracks may result, producing leaks that may manifest themselves far from the seat of the trouble.

As a built-up roof increases in age, it becomes increasingly important that it be given more frequent and careful inspection, for as it ages the more volatile constituents evaporate from the bituminous material, the roofing becomes brittle and thus more subject to small local failures which may spread into a general failure if they are not attended to promptly.

Should Not Fail

By Supervisor of Bridges and Buildings

If a built-up roof has been constructed of high-grade materials properly applied, and the workmanship is satisfactory, the roof should not fail until the natural process of disintegration has progressed to the point where it is no longer able to perform its function of protecting the building to which it is applied. For various reasons, however, this ideal condition rarely occurs in practice, for most roofs are subjected to conditions that create some form of damage or accelerate the natural processes of disintergration. Unfortunately, the materials going into roofs are not always of the best grade and it is equally unfortunate that the workmanship of application sometimes is poor.

If properly maintained, the life of a good roof can be extended many

years beyond the period when natural failure first becomes evident. This can be done by uncovering the surface, that is, removing the gravel or slag covering, and applying patches, or by adding a layer of felt to the whole surface and then restoring the gravel. In many instances the flashing gives as much or more trouble than the roofing itself, and improperly designed or improperly applied flashing may be the basic cause for failure of the roof. For this reason, the design of the flashing should be investigated before the roofing is applied and corrected if found faulty or inadequate. Likewise, the work of application should be given close supervision.

Many roofing failures can be traced to carelessness. The workmen should be required to wear rubber-soled shoes and no heavy tools or those having sharp edges should be allowed on the roof while the roofing is being applied. Dropping tools on the membrane or stepping on it with shoes having protruding nails may punch holes that are not easily detected, but which produce leaks later that are difficult to locate. Failure to mop each layer of roofing or the laying of plies on previous moppings that have been allowed to cool introduces defects that are sure to result in failure or partial failure and which are sometimes difficult to find.

A common cause of failure is lack of inspection and maintenance. The more volatile oils evaporate in the course of time and the roof then becomes brittle, and easily cracked. A careful watch when this stage is reached and prompt maintenance will make it possible to delay the renewal for several years, for a built-up roof can be maintained in serviceable condition for from 5 to 10 years beyond this period for only a fraction of the cost of a new roof.

Motor Trucks in Maintenance

In what ways can motor trucks be used to advantage in track maintenance?

Effect Savings

By F. F. Zavatkay
Supervisor of Welding and Equipment, New York, New Haven & Hartford, New Haven, Conn.

Through the use of commercial highway trucks by the track maintenance forces, the bridge and building forces and the signal maintenance gangs it is possible to effect substantial savings in the cost of transporting men and materials to and from headquarters on pre-arranged schedules or programs of maintenance work. On the New Haven this saving has been effected through the consolidation of supervisory forces, the elimination of much unproductive time and avoidance of the use of work trains, all of which have been made possible through an intensive use of automotive highway vehicles.

This reorganization and the motorizing of maintenance gangs were an outgrowth of experience gained in maintenance practices in a territory where the frequency of trains made it necessary for track maintenance to be handled by special gangs. The results of this original experiment were so satisfactory that the changes in the organization and the utilization of motor trucks were extended to cover the entire system. Preliminary to making this change, however, a study of the state and county highway systems had disclosed that all points on the railway where it would be necessary to deliver men and materials, were readily accessible from the highway. During this study careful consideration was given to the size, weight, capacity and body types to determine the trucks that would be best suited for the various departments and gangs and for the work that was to be performed by them.

Highway trucks are adapted particularly for use where train movements are frequent and where highways are so located that they are convenient to the railway. Under these circumstances highway trucks have shown their flexibility and economy. On the other hand, they have shown the same advantages in sparsely-settled sections, particularly on lines having limited train service, where highways are convenient to the railroad.

Trucks suitable for this service range from ½ to 3 tons in capacity. Large trucks with removable seats and body tops are used for transporting large gangs as well as their material and equipment. Small trucks with pick-up bodies are suitable for signal, water service, telegraph maintenance and other small gangs. The stores and mechanical departments also use a variety of trucks to advantage, the type and capacity depending on the particular service and the material to be handled. The fact that highways have proved their worth in railway maintenance has done much to remove the prejudice that once existed with respect to their use in railway service.

They Eliminate Delays

By M. B. Davis
Supervisor, Illinois Central, Kankakee, Ill.

Motor trucks are being used to advantage in track maintenance where the conditions are adapted for their use. For ordinary section work there is no substitute for the track motor car, as it provides the best means for patrolling the track and for transporting men and materials. However, in terminal territory where the tracks are not elevated or depressed, and where there are many industrial tracks, the motor truck has advantages over the motor car.

In my experience a 157-in. stake body is the most suitable type of motor truck. This body provides ample room for a complete assortment of tools, including a welder's kit for emergency work. There is also sufficient space to carry a supply of track fastenings, while crossties can be carried in a truck of this size, and it can be used to transport bituminous material to be used for repairs to highway grade crossings. On occasion, a light push car can be carried to facilitate the handling of materials from point of delivery to the work.

One of the principal advantages of the motor truck in switching territory or where other train movements are frequent, is the elimination of delays in getting to and from the work, and the consequent increase in productive time. The higher average safe speed is another advantage because of the time-saving element. The larger assortment of tools and materials that can be carried on the truck is an advantage in yard work, particularly when coupled with the earlier delivery. Again, the motor truck is available for answering emergency calls within a radius of 50 miles or more, thus providing a means for the delivery of men and tools quickly when occasion demands.

Furthermore, the motor truck provides an excellent means for transporting electric welding outfits for the repair of frogs and crossings in the track. The larger stake body provides ample room for both the generator and the grinder car, with skids for unloading the latter. A cable 300 ft. long is sufficient to reach almost any frog or crossing. The mobility of such a unit permits service over an extended territory with minimum delay in moving from point to point.

What Our Readers Think

Treated Ties

Estuary, Sask.

To the Editor:

I have re-read and have been thinking over the editorial with respect to treated ties, which appeared on page 306 of the May issue, and agree with the comments as to the treatment these ties receive both before and after they are given preservative treatment. As you state, great care is exercised to insure that only sound ties are taken up and treated, since the treatment of unsound timber is a waste of time and money.

In view of the care with which the ties are inspected originally and the extreme caution that is taken to preserve them from decay and other forms of damage during the seasoning period, it seems strange that only a few roads make any effort to educate their trackmen in the proper method of handling treated ties when distributing and renewing them, although all roads have rules covering their handling. Most section men do not realize the damage, or its consequences, that can be done to a treated tie when a pick or shovel blade is driven into it for the purpose of pulling it into position. A little education here will extend the life of many a tie.

Not a few of the spike-driving practices in vogue are also detrimental to the life of ties, especially those that are not prebored. More than once I have seen a man pull a spike out of a treated tie, plug the old hole very carefully, and then drive the spike at an angle different from the one driven originally, thus bringing the end of the spike sometimes as much as two or three inches away from the old hole. This is an exceedingly bad practice which should never be permitted, since it will weaken the tie.

Foremen should insist that spikes be driven straight down into the tie. Then when a spike is withdrawn the hole should be plugged and the spike replaced by driving it straight down into the plug. It can be readily understood that when spikes are withdrawn at different times from a given tie by different men and redriven by still others, rigid enforcement of this rule becomes necessary. If this is not done and the men are allowed to do the driving without supervision, since every man has his own set way of driving spikes, one will drive his spikes under the rail, another will drive with a slope of two or three inches from the vertical and in another direction, and the result will be a lot of ties that have been weakened at the point where they need to be the strongest. This is equally true for those ties that are protected by tie plates and those that are not.

J. Eichorn, Jr.
Section Foreman,
Canadian Pacific

Pumps Without Pump Houses

Houston, Tex.

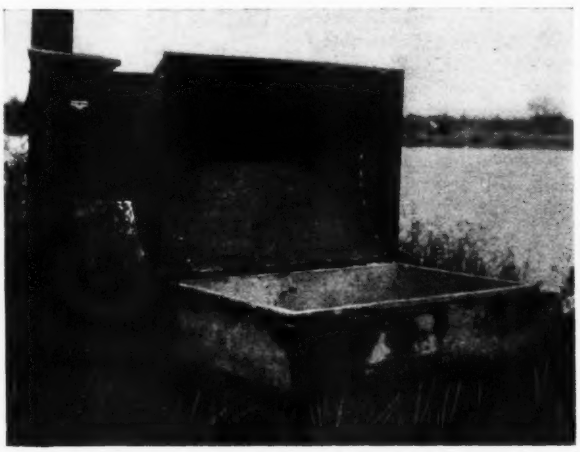
To the Editor:

On page 323 of the May issue, the belief is expressed that the water station at Crenshaw, Miss., is the first one in railway service in this country in which there is no pump house and no provision for a pumper. On the Southern Pacific lines in Texas & Louisiana, we have several electrically operated, automatic water-pumping stations without pumpers in attendance and without pumphouses, in the generally accepted meaning of the term. The first of this type was installed at Miller, Tex., in 1925; a similar installation was made at Edgerly, La., in May, 1928; and another was placed in operation at Boutte, La., in August, 1931. These pumping plants are all controlled automatically by a float valve.

We also have a similar installation with an electrically operated pump on the river side of the Mississippi river levee at Avondale, La. The pump is mounted at an elevation slightly above maximum high water, and discharges into a small tank erected on the top of the levee, from which the water flows by gravity about two miles to a reservoir in Avondale yard. This reservoir not only provides a reserve supply against sudden heavy demands, but also acts as a sedimentation basin, from which the water is passed as needed through a water-softening plant into elevated storage tanks.

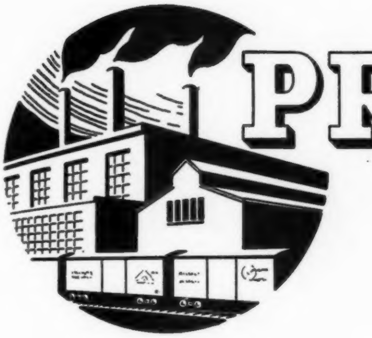
In this plant the operation of the pump at the river is automatic to the extent that when the reservoir in the yard is filled, the attendants there close the valve in the gravity line. This results in the filling of the tank on the levee, which is equipped with a float valve that shuts off the pump when the tank is full. When the valve in the gravity discharge line is opened, the water in the levee tank begins to flow into the reservoir, and the float valve again comes into action, starting the pump.

We believe that there are other automatic installations similar to ours, which antedate those on our line. In our plants the pumps are set in shallow concrete pits 4 ft. by 6 ft. in plan, and are protected from the weather by galvanized iron lids which can be closed and locked, as is shown in the illustrations. In the installation which Mr. Knowles described, this development has gone a step further, in that the deep-well pumps are equipped with weather-proof motors, so that they are exposed above ground without any form of shelter.



Automatic Water Pump Station at Boutte, Showing the 4-ft. by 6-ft. Concrete Pit Protecting the Pumping Machinery and the Galvanized Iron Lid Raised

E. A. Craft,
Assistant to Executive Vice-President
Southern Pacific Lines
in Texas and Louisiana



PRODUCTS of Manufacturers

New Flex-Toe Claw Bar

A CLAW bar with mechanical jaws that operate automatically has been perfected by the Warren Tool Corporation, Warren, Ohio. It is known as the Flex-Toe claw bar, and is designed to provide a safe claw bar for one-man operation, capable of pulling headless spikes or drift bolts and to pull spikes out straight.

The Flex-Toe Claw Bar Can Be Used to Pull Spikes Out Straight by Taking a Series of Bites on the Spike Shaft

The claw bar is similar to other types, with the exception of the gripper jaws or toes which are made of high strength forged and heat-treated alloy steel and so mounted in the head of the claw bar that the operation of the bar handle controls the gripping action of the jaws. The gripper jaws can be easily and quickly replaced in the field without delaying operations, and are said to bite and hold, even though only a slight amount of metal can be gripped. The grip of the jaws increases with the force applied on the bar handle.

A number of advantages are claimed for this claw bar, as compared to the ordinary types. In addition to its ability to grip and pull headless spikes and drift bolts, spikes can be pulled out straight by taking a series of bites on the shaft. It is also said that with this claw bar one man can do the work of two, and that it is much safer to use than other types of claw bars, because its ability to grip a small amount of metal eliminates the necessity of using a sledge to drive the claw bar under a spike head, with the attendant danger of flying pieces of metal.

Improved Tannin Brick Water Treatment

THE Dearborn Chemical Company, Chicago, has developed an improved tannin brick that is slowly soluble in both cold and hot water, and is designed for the prevention of scale deposits in water distribution and feed lines or for locomotive use to prevent scale deposits in injectors, boiler feed pumps, feedwater heaters and boiler checks.

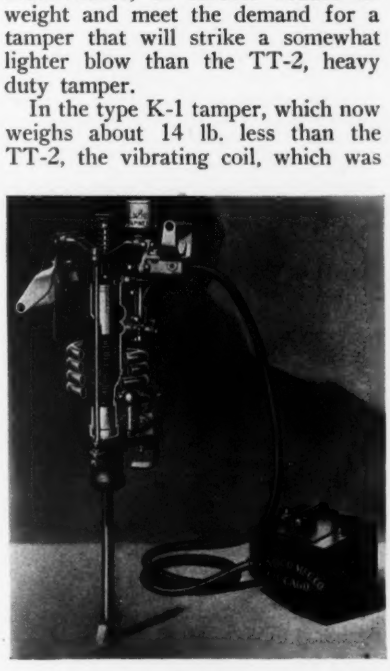
This new brick is a blend of tannins and organic and inorganic reagents combining the qualities of two types of tannins, those for use in hot locomotive boiler water for the prevention of scale deposit, and tannins for use in cold water in pipe lines and distribution lines. The tannins and organic and inorganic reagents in the new bricks are said to act chemically, to inhibit precipitation and keep the solids in "isolated solution," and physically, to keep the carbonate crystals from knitting together to form an adhesive scale. In this manner any solids that may be precipitated are carried over into the boiler, where they may be blown down. Other advantages claimed by the use of this brick are the inhibition of pitting due to oxygen and the prevention, under certain conditions, of intercrystalline corrosion or caustic embrittlement in the locomotive boiler.

The bricks are available in one, two and four-lb. sizes and are added to the water in pipe lines or distribution lines by a by-pass feeder; in locomotive water treatment they may be thrown directly into the locomotive tender or hung in a basket.

Improvements in Lightweight "Tytamper"

A NUMBER of improvements have been made by the Barco Manufacturing Company, Chicago, in its type K-1, lightweight "tytamper," which was described in the October, 1938 issue of *Railway Engineering and Maintenance,* to further reduce its weight and meet the demand for a tamper that will strike a somewhat lighter blow than the TT-2, heavy duty tamper.

In the type K-1 tamper, which now weighs about 14 lb. less than the TT-2, the vibrating coil, which was formerly attached to the tamper near the spark plug, has been placed in a new streamlined, battery box which can be dragged easily over ties, ballast and rails. The new battery box, also contains instructions for ready reference, printed on waterproof material on the battery box cover.



Showing a Part Cut-Away View of the Barco K-1 Tytamper and the New Streamlined Battery Box

NEWS of the Month

Historic Locomotive Goes to Fair Under Its Own Power

The William Crooks, one of America's historic locomotives, built at Paterson, N. J., in 1861, and now owned by the Great Northern, traveling under its own power and pulling two ancient coaches, left St. Paul on March 14 with a schedule providing for arrival in New York on March 27, where it is to be a part of the exhibition, Railroads on Parade, at the New York World's Fair.

Freight Trains Set Record for Speed in 1938

A new record for average speed of freight trains in the United States was established in 1938. The average distance traveled per train per day in that year was 398 miles, compared with 386 miles in 1937 and 247 miles in 1920. This represents the average time required for the movement of all freight trains between terminals, including delays en route, as announced by J. J. Pelley, president of the Association of American Railroads, on February 27.

Hopkins Gives Rail Rehabilitation a Boost

Secretary of Commerce Harry L. Hopkins in an address at Des Moines, Iowa, on February 24, stated that he was "firmly convinced" that "it is difficult to hope for anything like a complete recovery in America" until the problem of rehabilitating the railroads and relating them to our present and future economy is solved. "The railroads are and must be sustained as essential arteries of commerce and must be ready for use as part of our national defense."

Railway Express Gets Permission to Change Rates

On February 24, the Interstate Commerce Commission granted the Railway Express Agency authority to revise its rate structure to increase its revenues an estimated $10,000,000, on the ground that there has been an increase in the total cost of performing express transportation service in recent years. The revised rates will be increased on all commodities except on agricultural products and packages weighing less than 100 lb. In the case of agricultural commodities the increase will be applied only to the seasonal rates and not to the higher permanent rates, and on packages weighing less than 100 lb. the rates will be lowered. The Railway Express Agency Executives informed the commission that they expect the lowered rates on small packages to be more than offset by the increased volume of business which will be attracted by such rates.

New Four-Cylinder Locomotive at N. Y. Fair

A new locomotive and tender 140 ft. in length and weighing 526 tons has been built at the Pennsylvania's Altoona, Pa., shops, and will be exhibited at the New York World's Fair. The locomotive, which has four cylinders and is the first in the world to carry the 6-4-4-6 wheel classification, develops 6,500 hp. at 100 m.p.h. Its tender is supported by two 8-wheel trucks and has a capacity of 24,500 gal. of water and 25 tons of coal.

Capital Expenditures For Roadway in 1938

The Class I railroads of the United States made capital expenditures for roadway and structures in 1938 totaling $111,529,000 as compared with expenditures for similar purposes of $186,916,000 in 1937 and $544,339,000 in 1930. Of these expenditures in 1938, $17,247,000 went for heavier rail compared with $29,149,000 in the preceding year; $18,231,000 was expended for bridges, trestles and culverts, which was approximately $1,300,000 less than was spent in 1937; and $7,569,000 went for yards and sidings, as compared with $14,593,000 in the year before. Other expenditures for additional ballast, shops and enginehouses, station and office buildings, signals and for other improvements were in each instance less than in 1937. All of the above figures are exclusive of expenditures for maintenance charged to operating accounts. Total capital expenditures for all improvements, including mechanical equipment and rolling stock, amounted to $226,937,000 in 1938, as compared with $509,793,000 in 1937, and $872,-608,000 in 1930.

Court Kills Full Crew Law

In a decision by Judge J. E. Fox, of the Dauphin County Court at Harrisburg, Pa., the Railway Full Crew Act, placed in the Statutes of Pennsylvania on June 1, 1937, was held to be a violation of the commerce clause of the federal Constitution, an improper exercise of the police power, an interference with interstate commerce, and it was also held that the expenses entailed in conformity with the act would be out of proportion to the alleged advantages of safety. The act had required such use of extra man-power as two employees at the head end of electrically-propelled trains, baggagemen on locked cars and additional brakemen on trains of prescribed lengths.

Crossing Accidents Decrease in 1938

In 1938 fatalities resulting from highway-railroad grade crossing accidents totaled 1,517, fewer than any year since 1915, with the exception of one year—1933—when the number of deaths from this cause totaled 1,511. In 1937 the total number of such fatalities was 1,875. The total number of persons injured in highway-railroad grade crossing accidents in 1938 totaled 4,018, a decrease of 1,118 compared with the preceding year, and a total less than for any preceding year since 1916, with the exception of the two years 1932 and 1933.

Warns War Would Cause Transportation Crisis

Expressing the fear that a repetition of the experiences of the last war might occur, Colonel C. D. Young, vice-president of the Pennsylvania and chief of the railway section, office of chief of engineers, U. S. Army, warned his listeners in a speech before the Ohio Valley Advisory Board at Columbus, Ohio, on March 14, that if a national emergency should cause railroad tonnage to increase to an amount equal to or greater than the traffic volume of 1929, serious congestion would result, because the carriers of today own only 75 per cent as many locomotives and freight cars as they did in 1929. He added that in 1917, quoting W. G. McAdoo, federal administrator of railroads during the war, the traffic the railroads were called upon to carry was "so close to the limit of endurance that they were always on the very edge of a general breakdown in service." He also expressed the opinion that highway transportation is inadequate for mass transportation and, because of the predominance of small vehicles, would waste greatly needed man-power for transportation in emergency periods.

Personal Mention

General

C. W. Campbell, district engineer of the Northwestern and North Texas districts of the Missouri-Kansas-Texas, with headquarters at Denison, Tex., has been promoted to superintendent of the Northwestern district, with headquarters at Wichita Falls, Tex. Mr. Campbell was born at Santa Anna, Tex., on September 22, 1888, and entered railway service in July, 1909, as a roadmaster on the Northwestern district of the Missouri-Kansas-Texas. In September, 1912, he went with the Great Northern as an instrumentman and in January, 1916, he returned to the Katy as instrumentman on the Henrietta division. In December, 1917, he was promoted to roadmaster on that division and in May, 1918, he was advanced to assistant district engineer of the Northwestern district. Mr. Campbell was further advanced to district engineer of the Shreveport division in December, 1918, and was later transferred successively to Waco, Tex., and Wichita Falls, Tex. He was appointed district engineer of the Northwestern and North Texas districts in September, 1938.

C. W. Campbell

E. A. Craft, engineer of maintenance of way of the Southern Pacific Lines in Texas & Louisiana, with headquarters at Houston, Tex., has been promoted to assistant to the executive vice-president with the same headquarters. Mr. Craft was born at Danville, Ill., on September 11, 1893, and entered railway service in October, 1909, as a chainman on the Chicago & Eastern Illinois. He was later promoted to transitman and in 1914 he was advanced to assistant division engineer on the Evansville division, later being transferred successively to the Illinois and the Chicago divisions. In June, 1917, he was commissioned first lieutenant in the Engineer Officers Reserve Corps assigned with the 17th Engineers (Railway) at St. Nazaire, France. Mr. Craft was transferred to the Transportation Corps on November 1, 1917, and from January 1, 1918, to August, 1919, was a superintendent in the army transport service, receiving a commission as captain in October, 1918, and as major in February, 1919. After the war, he returned to the C. & E. I. as assistant engineer at Danville in October, 1919. In December, 1919, he went with the Southern Pacific as division engineer of the El Paso division, with headquarters at El Paso, Tex., and four months later he was appointed assistant to the engineer maintenance of way, with headquarters at Houston, Tex. In September, 1920, he was appointed assistant to the chief engineer. Mr. Craft was advanced to engineer maintenance of way in October, 1926, holding that position until his recent appointment which was effective on March 16.

E. A. Craft

Francis J. Nugent, trainmaster on the Chicago, Rock Island & Pacific, with headquarters at Fairbury, Neb., and an engineer by training and experience, has been promoted to superintendent of the Western division, with the same headquarters. Mr. Nugent was born at Waterloo, Iowa, on April 15, 1878, and graduated in civil engineering from the University of Iowa in 1903. He entered railway service after graduation as a material clerk on the Rock Island at Silvis, Ill. Later he transferred to the engineering and maintenance of way department and in 1909, he was promoted to roadmaster, with headquarters at Cedar Rapids, Iowa. Later that year he was appointed assistant engineer, with the same headquarters, and in 1910, he was placed in charge of the construction of a yard at Cedar Rapids. In 1911, he was advanced to office engineer, with headquarters at Chicago, and on February 1, 1912, he was promoted to division engineer, with headquarters at Little Rock, Ark. He then served as division engineer and office engineer on various divisions on the Rock Island, later being appointed division engineer of the Nebraska,Colorado division, with headquarters at Fairbury. On January 1, 1929, he was transferred to the Iowa division, with headquarters at Des Moines, Iowa, and in June, 1930, he was advanced to trainmaster on that division. Mr. Nugent was later transferred to Fairbury, the position he held at the time of his recent promotion.

Francis J. Nugent

F. H. Hibbard, acting superintendent and chief engineer of the Quebec Central, with headquarters at Sherbrooke, Que., has been appointed superintendent and chief engineer, with the same headquarters. Mr. Hibbard was born at Ottawa, Ont., on August 9, 1888, and entered railway service with the Transcontinental (now C. N. R.) in 1907, during construction. The following year he was appointed assistant engineer on construction of the Quebec Terminals. In 1911 he was promoted to resident engineer at Quebec and on completion of the work there in 1913 was appointed to the engineering staff of the Canadian Pacific and the Lake Erie & Northern in Ontario. Mr. Hibbard went with the Quebec Central later in the same year as engineer in charge of construction of the Chaudiere and Scotts extensions. He was promoted to engineer maintenance of way in 1924 and to chief engineer in 1931. His jurisdiction is now being extended to embrace all branches of operating service including the maintenance of way, motive power and car departments and highway motor coach services.

F. H. Hibbard

Engineering

W. H. Kyle has been appointed division engineer, Montreal Terminals, Canadian National, with headquarters at Montreal, Que., succeeding **W. H. B. Bevan,** who has been transferred to the Ottawa divi-

sion, with headquarters at Ottawa, Ont., to succeed **H. J. Black,** deceased.

R. S. Gutelius, acting division engineer of the Susquehanna division of the Delaware & Hudson, with headquarters at Oneonta, N. Y., has been appointed division engineer of that division.

A. L. Kleine, acting roadmaster on the Denver & Rio Grande Western, with headquarters at Helper, Utah, has been promoted to assistant engineer of track, with headquarters at Denver, Colo.

C. S. Weatherill, engineer maintenance of way of the Minneapolis & St. Louis, has been promoted to chief engineer, with headquarters as before at Minneapolis, Minn., succeeding **Ritchie G. Kenly,** who retired on April 1.

Roy A. Brown, roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Manly, Iowa, has been appointed acting division engineer of the Western division, with headquarters at Fairbury, Neb., relieving **E. F. Manson,** who has taken a leave of absence because of illness.

E. T. Barrett, who has been on a leave of absence while acting as superintendent of the Rio Grande Southern, has returned to his former position of engineer of track of the Denver & Rio Grande Western, with headquarters at Denver, Colo., and **G. M. Darby,** acting engineer of track, has returned to his former position as division engineer, with headquarters at Grand Junction, Colo., displacing **H. C. Cosand,** who has returned to his former position as division engineer, with headquarters at Salt Lake City, Utah.

Wesley C. Brown, assistant engineer on the Missouri-Kansas-Texas, with headquarters at Dallas, Tex., has been promoted to district engineer of the Northwestern and North Texas districts, with headquarters at Denison, Tex., replacing **C. W. Campbell,** whose promotion to superintendent of the Northwestern district is announced elsewhere in this issue.

Stanley G. Phillips, whose promotion to division engineer of the Terminal division of the Boston & Maine, with headquarters at Boston, Mass., was announced in the March issue of *Railway Engineering and Maintenance,* was born at Westbrook, Me., on February 26, 1895, and received his higher education at the University of Maine, graduating in 1917. He first entered railway service with the Lehigh Valley, serving with this company during the summer vacation period in 1915. After his graduation, Mr. Phillips returned to the Lehigh Valley as a levelman on the engineering corps, with headquarters at Sayre, Pa., remaining in this capacity for three months. He then joined the United States Army, where he remained until April, 1919, when he returned to the Lehigh Valley as a transitman at Sayre, holding this position until August, 1920. Mr. Phillips was then promoted to assistant division engineer with headquarters at Buffalo, N. Y., where he remained until January, 1927. At that time he was appointed assistant supervisor of track, with headquarters at Hazleton, Pa., and in March, 1928, he was advanced to supervisor of track with headquarters at Delano, Pa. In April, 1929, Mr. Phillips became connected with the Central Railroad of New Jersey as supervisor of track, with headquarters at Allentown, Pa., where he remained for six months, then being transferred to Jersey City, N. J. In November, 1929, he entered the service of the Boston & Maine as assistant division engineer at Boston, the position he was holding at the time of his recent promotion to division engineer.

Harold J. McKenzie, chief draftsman in the engineering department of the Southern Pacific Lines in Texas and Louisiana at Houston, Tex., has been promoted to assistant to the chief engineer, with the same headquarters, a newly created position. Mr. McKenzie was born in Houston 35 years ago. He graduated from Texas A. & M. College in 1927, and for three years after his graduation continued his studies in a Houston engineering school, specializing in structural engineering and design. He first entered

Harold J. McKenzie

railway service between terms of school in the summer of 1925 as a draftsman in the engineering department of the Southern Pacific. After graduation he returned to this work and after filling various positions in the drafting department, he was promoted to chief draftsman on March 1, 1936.

Track

E. Redmond has been appointed roadmaster of the First district of the Washington division of the Union Pacific, with headquarters at Walla Walla, Wash.

R. C. Violett, acting roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Iowa City, Iowa, has been appointed roadmaster, with the same headquarters.

H. J. Willard, acting division engineer on the Denver & Rio Grande Western, with headquarters at Salt Lake City, Utah, has returned to his former position as roadmaster, with headquarters at Helper, Utah, succeeding **A. L. Kleine,** whose promotion to assistant engineer of track, with headquarters at Denver, Colo., is announced elsewhere in this issue, and **G. B. Aydelott,** engineering assistant at Grand Junction, Colo., has been appointed assistant roadmaster at Grand Junction.

J. C. Resch, instrumentman on the Gulf Coast Lines (Missouri Pacific) at Palestine, Tex., has been promoted to roadmaster, with headquarters at Crystal City, Tex., succeeding **Mathew H. Smith,** who has retired on pension.

W. Bryant, roadmaster on the Canadian National with headquarters at Biggar, Sask., has been transferred to Edson, Alta., succeeding **M. M. Churchill,** who has been transferred to Calgary, Alta., replacing **F. C. Mackay,** who in turn has been transferred to Biggar, Sask., replacing Mr. Bryant.

Paul I. Buser, roadmaster on the Chicago, Rock Island & Pacific, with headquarters at Estherville, Iowa, has been transferred to Manly, Iowa, as acting roadmaster in the absence of **Roy A. Brown,** whose appointment as acting division engineer, with headquarters at Fairbury, Neb., is announced elsewhere in this issue. **I. W. Lucas,** roadmaster, with headquarters at Sibley, Iowa, has been transferred to Estherville, Iowa, replacing Mr. Buser, and **Clyde Murray,** track supervisor, has been promoted to acting roadmaster at Sibley succeeding Mr. Lucas.

Herbert C. Arnold, whose promotion to roadmaster on the Chicago, Burlington & Quincy, with headquarters at Curtis, Neb., was announced in the March issue, was born at Lucasville, Ohio, on March 9, 1906, and entered railway service on July 21, 1921, as a section laborer at Salem, Neb. In 1926, he was promoted to extra gang foreman and on April 15, 1930, he transferred to the Omaha division as assistant section foreman and extra foreman. Mr. Arnold was advanced to track supervisor on the Omaha division in June, 1935, and in April, 1936, he was transferred to the Alliance division, with headquarters at Ravenna, Neb.

A. M. Kennedy, assistant supervisor of track on the Pennsylvania at Washington, D. C., has been promoted to supervisor of track, with headquarters at Wheeling, W. Va. **G. C. Vaughan,** assistant supervisor of track on the Philadelphia Terminal division, has been advanced to supervisor of track at Homestead, Pa. **C. F. Parvin,** assistant on the engineer corps, has been promoted to assistant supervisor of track at Harrisburg, Pa., succeeding **J. W. Buford,** who has been transferred to Washington to replace Mr. Kennedy. **J. M. Minturn,** assistant on the engineer corps, has been promoted to assistant supervisor of track, with headquarters at Philadelphia, Pa.

James O. Stephens, whose retirement as track supervisor on the Louisville & Nashville, wth headquarters at Hazard, Ky., was announced in the February issue, was born at Livingstone, Ky., on July 30, 1873, and entered railway service on March 1, 1889, as a section laborer on the L. & N. at Colesburg, Ky. In the spring of 1902, he went with the Louisville, Henderson & St. Louis (now part of the L. & N.) as a section laborer at

Owensboro, Ky. Four years later, he became a track supervisor on the Louisville & Atlantic (now part of the L. & N.), with headquarters at Richmond, Ky. Mr. Stephens was later transferred to Hazard and held that position until his retirement.

B. E. Haley, general roadmaster of the Atlantic Coast Line, with headquarters at Lakeland, Fla., retired on March 1, because of ill health. **H. C. Koelz,** general roadmaster at Waycross, Ga., has been transferred to the general headquarters at Wilmington, N.C., and assigned to other duties. **E. J. Haley,** general roadmaster at Rocky Mount, N.C., has been transferred to Waycross, with jurisdiction over the Southern Lines of this railway, while the jurisdiction of **J. W. Hughes,** general roadmaster at Florence, S.C., has been extended over the Northern Lines of this system. **W. F. Corley,** roadmaster, with headquarters at Arcadia, Fla., has been transferred to Lakeland.

Leo E. Donovan, whose promotion to track supervisor on the Illinois Central, with headquarters at Clinton, Ill., was announced in the March issue, was born at Effingham, Ill., on April 14, 1906, and entered railway service on December 9, 1921, as a messenger in the superintendent's office at Champaign, Ill. One year later, he was promoted to accountant in the same office, later becoming supervisor's clerk in the division engineer's office at Champaign, and a timekeeper on construction work. On March 11, 1927, he was appointed accountant in the office of the auditor of capital expenditures at Chicago and in December of that year he returned to the Illinois division as a section laborer. In June, 1928, he was promoted to assistant section foreman and on January 1, 1937, Mr. Donovan was advanced to section and extra gang foreman, the position he held at the time of his recent promotion.

Robert A. Emerson, whose promotion to roadmaster on the Portage division of the Canadian Pacific, with headquarters at Deloraine, Man., was announced in the March issue of *Railway Engineering and Maintenance,* was born at Plum Coulee, Man., on April 12, 1911, and graduated in civil engineering from the University of Manitoba in 1930. He entered railway service in the summer of 1928 between terms of school, serving as a rodman in the engineering department on the Canadian Pacific at Kenora, Ont., and at Brandon, Man. The following summer he was employed as an inspector of rock ballasting at Kenora, Ont., and Fort William, Ont., returning to school in the fall. On May 2, 1930, he was appointed a transitman at Kenora, Ont. On October 1, 1930, he left the Canadian Pacific to become instructor in civil engineering at the University of Manitoba and later became successively locating engineer for the Department of Northern Development of the Province of Ontario, post-graduate student of railway transportation at Yale University and instrumentman for the Department of Northern Development. On April 1, 1935, he re-entered the service of the Canadian Pacific as a transitman at Vancouver, B. C., and was later transferred to Revelstoke, B. C., and Regina, Sask., where he was located at the time of his promotion.

John H. Battis, assistant track supervisor on the Boston & Maine, has been promoted to track supervisor on the New Hampshire division, with headquarters at Concord, N. H., succeeding **Joseph W. Hicks,** who has resigned to apply for annuity under the Railroad Retirement Act. Mr. Battis was born on May 14, 1905, at Woodsville, N. H., and attended the University of New Hampshire. He entered railway service on March 7, 1925, with the B. & M. and served in various clerical capacities until September 15, 1928. On that date Mr. Battis entered the engineering department, serving as a chainman, rodman and draftsman on the Connecticut River division until August 1, 1930, later serving as a rodman on the Fitchburg and New Hampshire divisions. From April 1, 1932, to June 30, 1933, Mr. Battis held the positions of trackman, assistant foreman and section foreman on the New Hampshire division and at the end of this period he was appointed assistant bridge inspector on the same division. On June 1, 1934, he was further promoted to assistant track supervisor on the New Hampshire division with headquarters at Concord. He was holding the latter position at the time of his recent appointment as track supervisor.

J. F. Barron, assistant roadmaster on the New Orleans & North Eastern (part of the Southern) and the New Orleans Terminal, with headquarters at Hattiesburg, Miss., has been promoted to roadmaster on the Mobile division of the Southern, with headquarters at Selma, Ala., succeeding **N. H. Self,** who retired on February 28. **T. Crawford,** assistant roadmaster, with headquarters at Louisville, Ky., has been transferred to Hattiesburg, Miss., replacing Mr. Barron, and **C. E. Price,** track supervisor, Birmingham Terminals, Birmingham, Ala., has been promoted to assistant roadmaster at Louisville, relieving Mr. Crawford. **W. C. Morris,** track supervisor, with headquarters at Somerset, Ky., has been transferred to the Birmingham Terminals, succeeding Mr. Price, and **W. F. Smock,** track supervisor, with headquarters at Selma, Ala., has been transferred to Somerset, Ky., replacing Mr. Morris. **R. B. Rust,** assistant supervisor of track at Birmingham, Ala., has been promoted to track supervisor at Selma, Ala., relieving Mr. Smock, and **S. T. Montgomery, assistant** to roadmaster at Somerset, Ky., has been promoted to assistant supervisor of track at Birmingham, succeeding Mr. Rust.

Mr. Barron was born at Owensboro, Ky., on January 1, 1892, and attended the University of Kentucky. He entered railway service on January 3, 1913, as a rodman on the Cincinnati, New Orleans & Texas Pacific (part of the Southern system) at Danville, Ky., and the following November he was promoted to transitman. He was advanced to junior engineer at Chattanooga, Tenn., in February, 1917, and in April, 1920, he was appointed assistant engineer at Macon, Ga. In February, 1927, Mr. Barron was promoted to bridge and building supervisor, with headquarters at Somerset, Ky., and on January 1, 1933, he was appointed assistant roadmaster, with headquarters at Hattiesburg, Miss.

Mr. Self was born at Wilsonville, Ala., on August 11, 1868, and entered railway service on August 1, 1886, as a bridge and building carpenter on the Georgia Pacific (now part of the Southern). On July 1, 1889, he was promoted to bridge and building foreman and served in that capacity on the Birmingham division and on the New Orleans & North Eastern (part of the Southern), until September 1, 1905, with the exception of two years as a section foreman. On the latter date he was appointed a track supervisor and on December 15, 1905, he was promoted to roadmaster on the N. O. & N. E. Mr. Self was later transferred to Birmingham, Ala., Sheffield, Ala., and Selma, Ala., where he was located at the time of his retirement after almost 53 years of continuous service.

Obituary

Daniel C. Rounseville, retired assistant chief engineer of the Chicago & North Western, whose death at Oak Park, Ill., on February 28, was announced in the March issue of *Railway Engineering and Maintenance,* was born at Sheboygan Falls, Wis., on October 29, 1856, and entered railway service on April 1, 1879, as a chainman on location on the Milwaukee, Lake Shore & Western (now part of the North Western), later being promoted to instrumentman, assistant engineer and division engineer. In 1895, he was appointed assistant engineer on the North Western and in 1897, he was promoted to division engineer. He served in that position and as resident engineer on construction of various lines in Wisconsin and Illinois until 1914, when he was advanced to engineer of maintenance. In 1918, he was promoted to assistant to the chief engineer and two years later he was further advanced to assistant chief engineer. Mr. Rounseville retired in November, 1926.

Louis H. Barker, who retired on March 1, 1921, as resident engineer of the Pennsylvania, with headquarters at New York, died on February 20 at his home in Croton-On-Hudson, N. Y., at the age of 87. Mr. Barker was born at New Brighton, Pa., on September 6, 1851, and entered the service of the Pennsylvania on August 10, 1876, as assistant supervisor, Baltimore division. He subsequently served as assistant engineer, engineer maintenance of way and principal assistant engineer in the maintenance of way department until January 1, 1905, when he was appointed assistant chief engineer. When the construction of the tunnels under the Hudson and East rivers was undertaken for the extension of the Pennsylvania into New York, Mr. Barker was transferred to this project as resident engineer of Sunnyside Yard, Long Island. Upon the completion of the Pennsylvania railroad extension in New York, Mr. Barker was appointed resident engineer, with headquarters at New York, where he remained until his retirement.

NOW! A ONE-MAN CLAW BAR • NO HELPER NO DRIVING

● A new development in labor saving, time saving and safety for track gangs—makes removal of spikes and drift bolts a one-man job, faster and more efficient.

The Flex-Toe Claw Bar, with toes open, is put in place and automatically grips the spike with a slight pull—the greater the pull the tighter it holds. High strength forged and heat treated alloy tool steel gives this fool-proof, simply constructed tool long life under constant use. One man now does two men's work.

1. The open jaws are put in place.

2. Leverage closes jaws, grasps spike and pulls.

3. Repeated bites and leverage extract spike straight out.

Patent No. 2,026,581

6 NEW SPIKE PULLING FEATURES

1—A ONE-MAN TOOL—no driving with a spike maul or sledge.
2—Eliminates the hazard of personal injury due to pieces flying from maul or heel of bar, or hand injuries from striking opposite rail.
3—Moving gripper jaws grasp spike automatically.
4—Pulls headless spikes and drift bolts.
5—Replaceable toes—simple construction. Eliminates shop redressing—toes can be replaced in field.
6—Spikes pulled out straight.

WRITE TODAY FOR PRICES AND FURTHER INFORMATION

WARREN SAFETY
FLEX-TOE
Claw Bar

WARREN TOOL CORPORATION • WARREN, OHIO

Association News

Wood Preservers' Association

Officers and members of the Executive committee met at the Palmer House, Chicago, on March 16, to appoint committees and otherwise organize the work for the new year.

Track Supply Association

Lem Adams (Oxweld Railroad Service Company), president, has called a meeting of the officers and members of the Executive committee on April 4 to consider plans for the exhibit to be presented at the Hotel Stevens, Chicago, on September 19-21, concurrently with the convention of the Roadmasters and Maintenance of Way Association.

Metropolitan Track Supervisors Club

The next meeting of the club will be held at the Hotel McAlpin, New York City, on April 13. Following dinner, which will be served at 6:30 p.m., the club will be addressed by John V. Neubert, chief engineer maintenance of way of the New York Central System, who will speak on Development of the Track Structure. Following Mr. Neubert's address, the club will hold its annual meeting and the election of officers.

B. & B. Exhibit

At a meeting of the Executive committee of the Bridge and Building Supply Men's Association in Chicago on March 14, decision was reached to proceed with plans for an exhibit in connection with the convention of the American Railway Bridge and Building Association on October 17-19 at the Hotel Stevens, Chicago, and arrangements were made to send applications for space reservations to members and prospective exhibitors at an early date.

Bridge and Building Association

The Proceedings of the last convention are now on the press and it is expected that they will come from the bindery in time to be distributed to the members during April. Following the decision of the Bridge and Building Supply Men's Association to present an exhibit in connection with the next convention, the association has arranged to hold its meeting on the lower floor of the Hotel Stevens, Chicago, where immediate proximity to the exhibit is afforded members to study the exhibit with the maximum convenience between sessions.

Roadmasters Association

The Proceedings of last September's convention have come from the printer and Secretary C. A. Lichty is now mailing them to the members. Interest in the association is being maintained at a high level, as evidenced by the receipt of 65 applications for membership to date since the last convention. Reports from the committees indicate that all of them are actively engaged in the preparation of their reports and that they will have them ready for review by the Executive committee at a meeting to be held in the early summer. B. E. Haley, general roadmaster, Atlantic Coast Line, has relinquished the chairmanship of the committee appointed to report on The Roadmaster's Qualifications and Duties on account of his retirement from railway service, and J. M. Miller, division engineer, Western Maryland, vice-chairman, has taken over the chairmanship.

Maintenance of Way Club of Chicago

Sixty-four members and guests attended the dinner-meeting of the club on March 27, at the Auditorium Hotel in Chicago, when three speakers discussed the subject "Young Men—and The Railway Field." The three speakers were C. E. Morgan, superintendent of work equipment and track welding, Chicago, Milwaukee, St. Paul & Pacific; E. L. Potarf, district engineer, maintenance of way, Chicago, Burlington & Quincy; and V. G. Walling, division superintendent track and roadway department, Chicago Surface Lines. The next meeting will be held at the Auditorium Hotel on Monday, April 24.

American Railway Engineering Association

At the meeting of the Board of Direction immediately after the close of the convention in Chicago on March 16, it was announced that, acting on the recommendation of A. O. Ridgway, chief engineer, Denver & Rio Grande Western, and chairman of the Committee on Economics of Bridges and Trestles, who was of the opinion that the committee had developed its assignment to a point that offered little opportunity for further constructive work, the committee had been discontinued. In addition, it was announced that C. J. Geyer, engineer maintenance of way, Chesapeake & Ohio, and F. R. Layng, chief engineer, Bessemer & Lake Erie, had been appointed representatives of the association to serve on the joint committee of railway associations and allied railway supply organizations to consider the proposal of the Committee for the Consolidation of Railway Supply Associations for a change in the dates of conventions to permit all of these associations to hold their conventions concurrently or consecutively at some time during the year.

The committees on Outline of Work and Personnel have completed the make-up of committees and the assignment of subjects for the ensuing year, and the booklet containing the assignments and personnel of committees will be mailed to all members of committees during the first week in April. It was announced further that Committee XII, Rules and Organization, the activities of which were suspended temporarily during 1938, will resume its work with W. T. Dorrance, assistant to chief engineer, New York, New Haven & Hartford, New Haven, Conn., as chairman, and J. C. Irwin, valuation engineer, Boston & Albany (retired), Boston, Mass., as vice chairman.

Other changes announced in connection with committee personnel include the appointment of eight new committee chairmen and vice-chairmen. Vice-Chairman W. G. Arn, assistant engineer, Illinois Central, Chicago, succeeds C. J. Geyer, Chesapeake & Ohio, as chairman of the Committee on Track, and A. E. Perlman, engineer maintenance of way, Denver & Rio Grande Western, Denver, Colo., has been appointed vice chairman; vice-chairman L. H. Laffoley, assistant engineer buildings, Canadian Pacific, Montreal, Canada, succeeds O. G. Wilbur, assistant engineer, Baltimore & Ohio, Baltimore, Md., as chairman of the Committee on Buildings, and A. C. Copeland, office engineer, Chesapeake & Ohio, Richmond, Va., has been appointed vice-chairman; vice-chairman G. M. O'Rourke, district engineer, Illinois Central, Chicago, succeeds F. S. Schwinn, assistant chief engineer, Missouri Pacific Lines, Houston, Tex., as chairman of the Committee on Economics of Railway Labor, and L. L. Adams, engineer maintenance of way, Louisville & Nashville, Louisville, Ky., has been appointed vice chairman; F. L. Nicholson, chief engineer, Norfolk Southern, Norfolk, Va., succeeds E. M. Hastings, chief engineer, Richmond, Fredericksburg & Potomac, Richmond, Va., as chairman of the Committee on Standardization.

The next convention of the association will be held in Chicago on March 12, 13 and 14, 1940.

Supply Trade News

General

The Beckwith Machinery Company, Pittsburgh, Pa., has been appointed representative of the **Bucyrus-Erie Company,** Milwaukee, Wis.

William J. Roehl, Inc., has been appointed representative for **Templeton, Kenly & Co.,** Chicago, for the St. Louis, Mo., territory.

Personal

W. H. Kreer, representative for the Middle West for **Templeton Kenly & Company,** Chicago, has been appointed sales engineer, with headquarters at Chicago.

Malcolm W. Reed, vice-president in charge of operation of the **American Steel & Wire Co.,** has been appointed chief engineer of the **Carnegie-Illinois Steel Corporation,** to succeed **Sydney Dillon,** who has been moved to the office of the chief engineer of the **United States Steel Corporation. Harvey B. Jordan,** assistant vice-president of the **American Steel & Wire Co.,** has been promoted to vice-president in charge of operations, with headquarters at Cleveland, Ohio, replacing Mr. Reed.

Patented and Patents Pending

3 REASONS WHY

RAILROADS ARE BUYING THE NEW WOOLERY TIE CUTTER

1. *Does A Better Job*

The Woolery Method of Tie Replacement eliminates deep trenching and jacking up the track—practically eliminates retamping and handling of ballast—does not disturb the underlying tie bed.

2. *Does A Quicker Job*

Cutting ties into three pieces makes removal quicker and easier. End sections are pried out with a bar and center sections are easily lifted out. Handling and disposal of old ties is also made easier and quicker.

3. *Saves 30% or More*

Railroad operating cost records show that savings of 30% or more on tie replacement costs are ordinary when the Woolery Tie Cutter is used.

ARRANGE FOR A DEMONSTRATION

Demonstrations without obligation are now being arranged. Let us prove what the Woolery Tie Cutter will do for you under actual operating conditions on your railroad.

SEND FOR BOOKLET

A new 12 page booklet is ready for distribution showing the operation and savings of the New Woolery Tie Cutter. Your request will bring it by return mail.

WOOLERY MACHINE COMPANY

MINNEAPOLIS MINNESOTA

Pioneer Manufacturers of
RAILWAY WEED BURNERS · MOTOR CARS
BOLT TIGHTENERS · TIE SCORERS · HEAVY
DUTY WORK CARS · TIE CUTTERS

WOOLERY MINNEAPOLIS

RAILWAY MAINTENANCE EQUIPMENT

8 Tool "High Speed" Tamping Outfit Spot Surfacing in Cinder Ballast.

SYNTRON

"HEAVY BLOW" ELECTRIC TAMPERS

For Efficient and Economical Stone Ballast Tamping

IN ADDITION TO

"HIGH SPEED" ELECTRIC TIE TAMPERS

For Tamping Small Stone, Gravel, Cinder, Chat and Other Soft Ballasts.

BUILT IN COMPLETE 2 TOOL—4 TOOL—6 TOOL—8 TOOL—12 TOOL—16 TOOL OUTFITS

SYNTRON CO., Homer City, Pa.

The MECO LUBRICATOR

is usually installed so that it serves not just one, but several curves, covering an extensive curve territory.

- Reduces cost of maintaining gauge and line on curves.
- Decreases replacement cost by prolonging curve-rail life.
- Decreases train resistance—cuts fuel costs.
- Prevents wheel screeching on curves.
- Increases safety of train operation and permits higher speeds.
- Often eliminates helper service or permits higher tonnage ratings, where curve resistance is governing factor.

MACK Switch Point Protectors | **RICHTER Blue Flag Derails**

Over 3000 Mecos Are in Service on More Than 100 Railroads

MAINTENANCE EQUIPMENT CO.

RAILWAY EXCHANGE BLDG., CHICAGO

ALPHABETICAL INDEX TO ADVERTISERS